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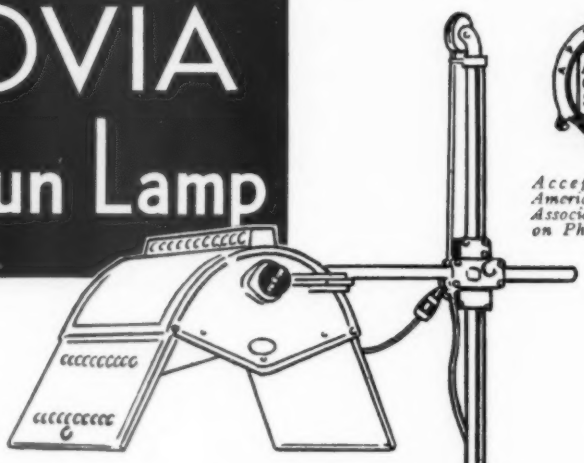

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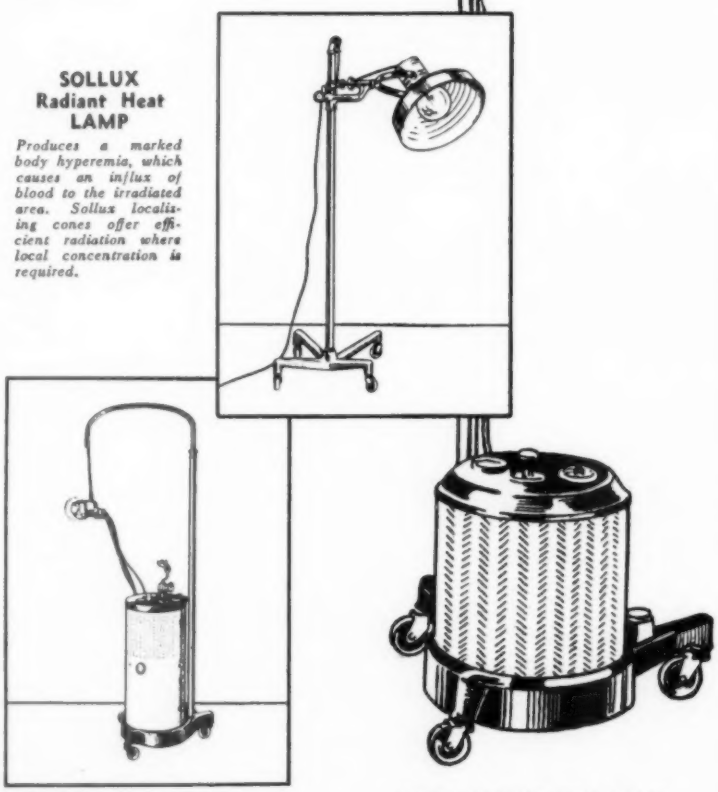

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PASSIVE VASCULAR EXERCISE FOR DISEASES OF PERIPHERAL VESSELS *

Description of a New Device

FRANK HAMMOND KRUSEN

Section on Physical Therapy, The Mayo Clinic

ROCHESTER, MINNESOTA

In 1932, Gibbon and Landis[1] demonstrated that, if the forearm of a normal individual is immersed in water at a temperature of 45.5 degrees C. for thirty-five minutes, thermocouples placed on the toes will give evidence of vasodilatation of the feet and a rise in temperature of the toes of from 10 to 15 degrees C. (Fig. 1.) They further observed that in patients with arteriosclerosis or other form of obliterative arterial disease, the organically diseased vessels could no longer dilate normally when the test was applied; moreover, the rise in temperature of the toes would be only partial, or there might be no rise.

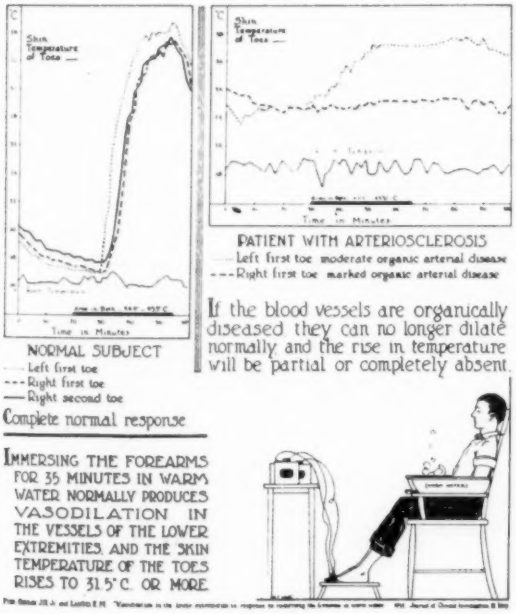
Skin Temperature of Toes
Time in Minutes
NORMAL SUBJECT
Left first toe
Right first toe
Right second toe
Complete normal response
IMMERSING THE FOREARMS FOR 35 MINUTES IN WARM WATER NORMALLY PRODUCES VASODILATION IN THE VESSELS OF THE LOWER EXTREMITIES AND THE SKIN TEMPERATURE OF THE TOES RISES TO 31.5°C. OR MORE
PATIENT WITH ARTERIOSCLEROSIS
Left first toe moderate organic arterial disease
Right first toe marked organic arterial disease
If the blood vessels are organically diseased they can no longer dilate normally and the rise in temperature will be partial or completely absent.

Fig. 1. — Vasodilatation in the feet, produced by immersing the hands and the forearms in cold water. (After Landis & Gibbon.)

In an article published in September, 1933, Landis and Gibbon[2] wrote: "From the therapeutic standpoint, patients with peripheral vascular disease are divided into two groups, (a) those whose symptoms are due to simple spasm with no, or very slight, organic vascular obstruction and (b) those whose symptoms are due primarily to advanced organic disease of the arteries." They noted further that the symptoms of the first group usually could be alleviated by producing vasodilatation with drugs, diathermy, local application of heat in the form of the warm cradle, or sympathetic ganglionectomy, and that the efficacy of these therapeutic procedures depended on local dilatation of the peripheral blood vessels.

"In more advanced stages, however, obliterative structural disease has usually progressed until the arterial vessels are transformed into rigid tubes. These diseased vessels have not only abnormally small lumina but are also more or less incapable of dilatation even when vasomotor tone is reduced by nerve block or by a sympathetic ganglionectomy. When the arteries have thus lost their power of dilating, the therapeutic procedures mentioned above fail to increase blood flow and therefore are unable to improve the nutrition of the tissues. Eventually many of these patients with advanced organic disease of the arteries suffer from trophic changes, ulceration and gangrene, necessitating finally amputation. Any procedure which tends to increase blood flow in the presence of organic occlusion might be of benefit in delaying or possibly preventing the appearance of gangrene."

Gibbon and Landis pointed out:

According to Poiseuille's law the amount of fluid flowing through a rigid tube depends upon the fall in pressure along the tube. If other factors remain constant doubling the peripheral

* Read at the Fourteenth Annual Session of the American Congress of Physical Therapy, Kansas City, Missouri, September 11, 1935.

fall in blood pressure should approximately double the amount of blood flowing through the rigid arterial vessels. The total fall in pressure in the peripheral vascular system may be increased in two ways: (a) By elevating systemic blood pressure or (b) by diminishing capillary and venous blood pressures. The first method is impracticable for numerous reasons.

The authors concluded that it seemed possible to reduce capillary and venous pressures in an extremity by applying suction. They stated that the full effect of such suction could be obtained only if there was a reservoir to accommodate the blood which had flowed through the narrowed arteries, and they showed that the capillaries and veins, when not constricted, offered such a reservoir of limited capacity. They further concluded that "it seemed possible that the periodic application of negative pressure to the surface of the lower extremity might be expected to increase blood flow even though the arterioles had been changed into rigid tubes by reason of the structural disease."

Most important of all, they made the observation, apparently not previously made:

The accumulation of blood in the capillaries and veins must lead to stretching of their walls, the resistance to further distention increasing as the amount of trapped blood becomes greater. This resistance would, of course, lessen the effect of external suction on the peripheral drop in blood pressure particularly if suction were prolonged. It seemed essential, therefore, not only to use relatively brief periods of suction but also to empty the capillary and venous beds of their contained blood after each brief suction period, so that space might be available for the accommodation of fresh arterial blood to be drawn in during the succeeding suction period. Therefore, suction and pressure were applied alternately.

They described a device for the application of alternate suction and pressure. They studied its effects in a circulatory schema, on the lower extremities of normal subjects, and on the lower extremities of patients who had peripheral vascular disease. They reached the following conclusions:

As an application of Poiseuille's law the effects of alternate suction and pressure on the flow of blood through the lower extremities were studied in normal subjects and in patients with peripheral vascular disease. Increased rate of blood flow was identified by rise in skin temperature under carefully controlled conditions.

In a circulation schema it was found that alternate suction and pressure increased by 45 to 78 per cent the rate at which fluid flowed past an obstruction.

In normal subjects alternate suction and pressure (a) diminished the rate of cooling of an extremity originally warm and (b) in the majority of instances caused an originally cold extremity to become conspicuously warmer. Suction and pressure sometimes failed to affect blood flow in the cold extremity, but as soon as vasoconstrictor tone was diminished slightly, blood flow was conspicuously and preferentially increased in the extremity exposed to external pressure variations.

The vasodilator response to warming one forearm was studied in normal subjects with and without the use of external pressure changes. Alternate suction and pressure caused the vasodilator response to appear earlier and the final skin temperatures reached were definitely higher in the extremity exposed to external pressure changes.

In patients with peripheral vascular disease alternate suction and pressure increased blood flow even though organic obstruction had advanced to such a stage that no rise in skin temperature was obtained when vasoconstrictor tone was completely abolished by immersing both forearms in warm water or by anesthetizing the posterior tibial nerve.

The effects of suction and pressure on cyanosis associated with peripheral vascular disease are briefly discussed.

To obtain maximal effects on blood flow it is apparently advisable to have (1) relatively brief periods of suction, (2) intermittent, brief periods of pressure and (3) diminished vasoconstrictor tone.

Treatment by Intermittent Negative Pressure

Reid and Herrmann,[3] in June, 1933, had recommended the treatment of obliterative vascular diseases by means of an intermittent negative pressure environment, but not until later did they write of the important alternating phases of positive pressure. The use of negative pressures alone in the treatment of vascular diseases is not new. Herrmann and Reid[4] attributed to Sir James Murray, of Dublin, the first application of this principle to the treatment of disease (Fig. 2). They stated: "As early as 1812, he subjected animals as well as patients to various degrees of rarefied and compressed air." Murray published his work on this subject in 1832.

In 1829, Victor Theodore Junod,[5] a Frenchman, constructed his first pneumatic apparatus, which he described as follows: "This chamber or apparatus consisted of a large recipient of iron, pierced with holes and fitted with glass, and in this receptacle the air could be compressed or rarefied at will, by means of an air pump. A tap fitted to it enabled me to admit or retain the air

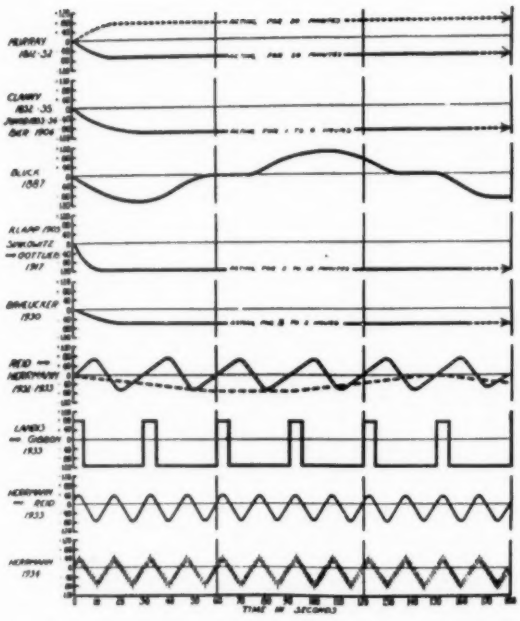

Fig. 2. — The more important methods of applying negative and positive pressure to the body or extremities. (After Herrmann & Reid.)

at will, according to the indications of a manometer or a barometer."

Junod's leg boot, made in 1834, bears a startling resemblance to that of Herrmann and Reid described just one century later.

Following Murray and Junod came Clanny, Bluck, and, in 1904, Bier. The studies on "Bier's hyperemia" attracted much more attention than did any of the previous work. But whereas Bier's treatment produced merely a passive congestion, with stagnation of blood in the treated part, because he applied suction alone, Landis and Gibbon's alternating positive and negative pressures produce an active hyperemia, with increased blood flow through the treated extremity. This appears to be the crux of the situation and the important advance in pressure therapy.

Herrmann and Reid[6] have contributed materially to this advance by their careful clinical study of 3,769 treatments with passive vascular exercise. They reported particularly on 51 patients who had obliterative vascular disease of one or more extremities. Of these patients, 32 had a high degree of peripheral (senile) arteriosclerosis without evidence of gangrene. Five had trophic lesions of one or more toes, together with moderately severe diabetes mellitus. Six had extensive thrombo-angiitis obliterans. Four had syphilitic obliterative arteritis, and four, atypical arterial disease of the obliterative type. Diagnosis were confirmed by complete vascular studies. They reached the following conclusions:

A total of 3,769 treatments with the Pavaex unit have been given up to July, 1933. Over three thousand of the treatments have been given to the 51 patients reported in this article.

Calorimetric evidence of an increase in the circulation in the distal parts of the extremities occurred in all patients of the series, yet 13.73 per cent received little or no relief from their symptoms.

Forty-four patients (86.27 per cent) were greatly benefited by this form of therapy.

Shipley and Yeager[7] confirmed the above work. They urged early diagnosis and conservative treatment of peripheral circulatory diseases. They pointed out that the development of a collateral circulation is the means by which improvement is brought about. They presented a series of cases confirmatory of the results of Herrmann and Reid, and they expressed the belief that such a method "has great possibilities, as a therapeutic measure, not only in thrombo-angiitis obliterans, arteriosclerosis and various occlusive diseases but also in ununited fractures, arthritis (atrophic and hypertrophic), frostbite gangrene, and the various circulatory disturbances that result from trauma."

Herrmann and Reid[8] wrote: "Thus far the benefits of the Pavaex treatments have been least obvious in those patients with extensive obliteration of the arteriolar bed of the feet, and most striking when the pathological changes were primarily limited to the major or secondary arterial pathways, especially when there was a rapid occlusion of the artery by embolism, trauma, surgery or thrombosis."

Allen and Brown,[9] of The Mayo Clinic, have felt that the Pavaex method of Herrmann and Reid "constitutes a small but as yet illy defined contribution to the treatment of vascular diseases." They expressed the belief that the Pavaex treatment of chronic occlusive arterial diseases, "increases the skin temperature temporarily, may relieve pain of ischemic neuritis and trophic changes and may induce healing of ulcers." They have felt that it is not clear that the results are superior to those following other and simpler methods of treatment. However, it is their impression "that the pain

of ischemic neuritis is relieved to a greater degree than ordinarily observed."

Landis and Hitzrot[10] recently have reported favorably on the clinical value of the somewhat different type of negative and positive pressure apparatus developed according to the principles laid down by Landis and Gibbon. However, it remains to be seen whether it is more or less effective than the Pavaex machine. It would seem that considerably more clinical data concerning the Gibbon and Landis device should be obtained before the rather promising early results of these investigators can be confirmed or refuted.

It has been noted by de Takats[11] that the machines for production of passive vascular exercise need further perfection; that the cuffs now used constrict the leg too firmly and thus prevent return of blood; that the machines are too noisy; that the boots are too short, and that the apparatus is difficult to manage.

With these thoughts in mind, after consultation with Dr. Eugene Landis, there

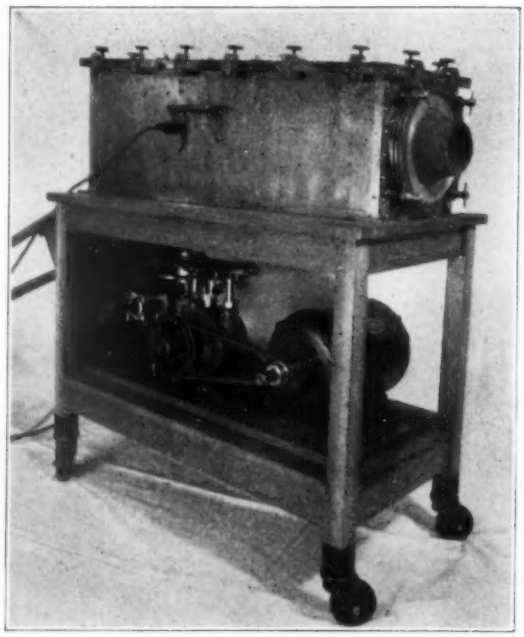

Fig. 3. — Apparatus for passive vascular exercise, showing motor, blower, rotating valve and relief valve mounted on lower platform of movable stand; also, detail of air-tight fastening for cuff.

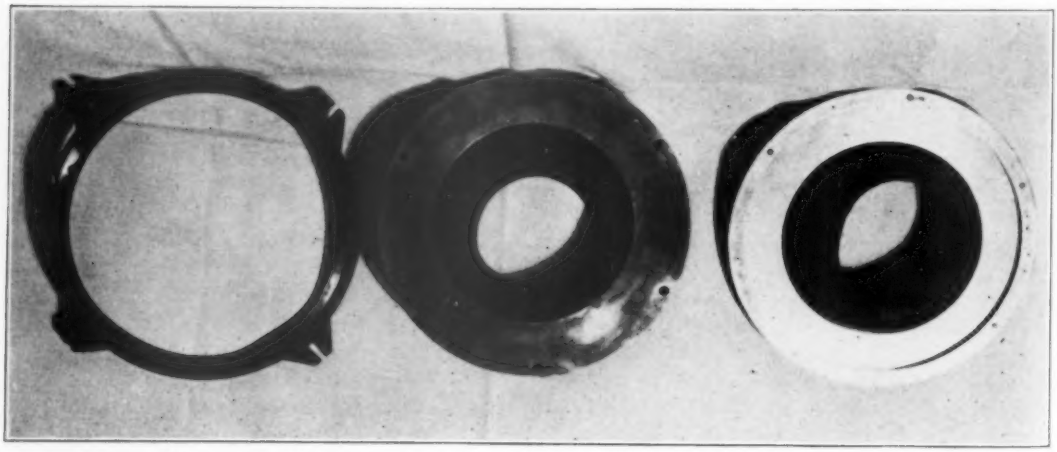

Fig. 4. — Conical cuffs which extend up and down the thigh, and the ring which fastens them to the boot.

was constructed in the experimental machine shop at Temple University Medical School, a new type of apparatus, modeled after Landis' experimental apparatus, but somewhat simplified (Fig. 3). A similar apparatus, developed entirely independently, was recently described by James Short.[12]

Author's Device

The apparatus constructed at Temple University, and described herewith, somewhat resembles Short's machine, but to meet de Takáts' suggestions, the boot has been lengthened so that it fits well up the thigh. The entire apparatus has been placed on a movable stand which is of the same height as the treatment tables in the clinic, so that it may be rolled up to the patient with ease. In addition, handles have been placed on the sides of the boot so that it can be easily lifted to a bed or treatment table. A long hose makes it possible to

leave the machine outside the treatment room, and thus noise is minimized. In addition, it is planned to produce further insulation against sound by means of rubber, felt, and closed walls.

In place of the mercury manometer used by Landis, relief valves, which can be controlled from the panel at the end of the table, have been substituted. As an additional factor of safety, two relief valves have been placed on the boot.

operates the device (Fig. 5). This valve rotates in such a manner that positive pressure is applied for five seconds; then there is a sudden shift to negative pressure for twenty-five seconds, and then another rapid shift to positive pressure, the cycles continuing in this manner.

The pressures may be varied by means of the relief valves (Fig. 6). The routine suggested by Gibbon and Landis has been followed; that is, twenty-five seconds of

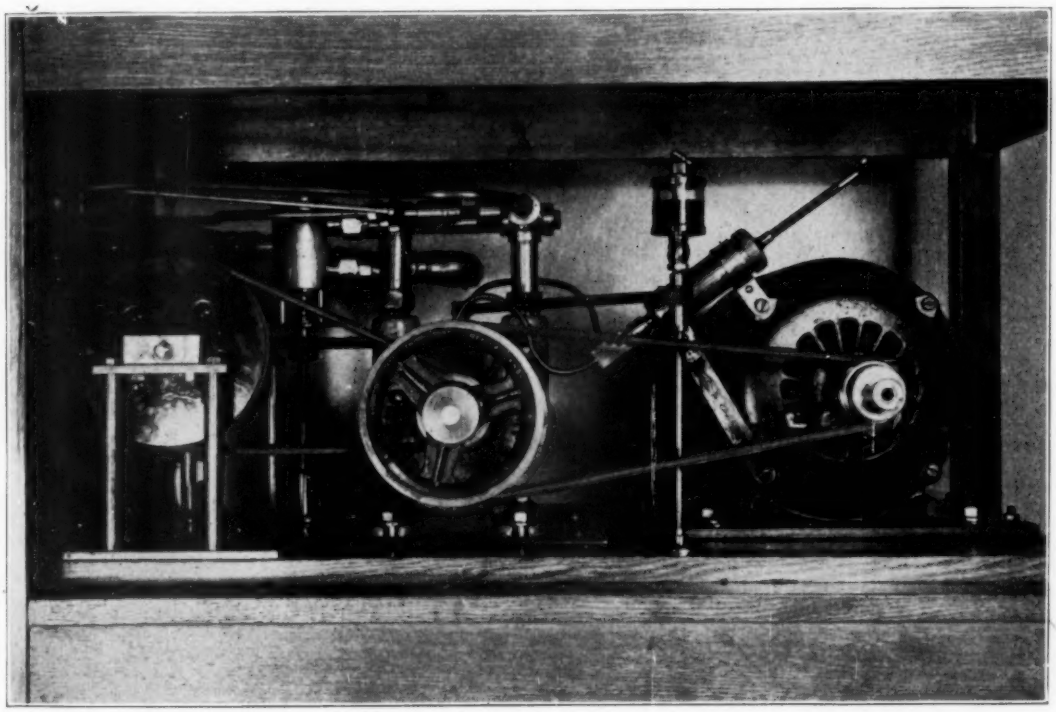

Fig. 5. — Present construction of the mechanism, showing large motor, blower, and rotating valve now operated by pulley and worm gear attached to the single large motor. The more convenient location of the oiler and the addition of a grease gun to lubricate the blower are noteworthy.

The cuff, used by Landis, with rubber cones extending up and down the thigh, has been split in half, so that it can be applied in two sections, thus greatly facilitating smooth application with a minimum of constriction (Fig. 4). There is, however, need for perfection of a still more satisfactory, less constricting cuff.

At first, a small auxiliary motor was used to turn the valve by which the positive and negative pressure is made to alternate. Recently, following Short's[12] suggestion, the apparatus has been simplified by operating this valve by means of pulleys and gears attached to the single large motor which

negative pressure (at 120 mm. of mercury), and five seconds of positive pressure (at 80 mm. of mercury).

A reinforced $\frac{3}{16}$ inch celluloid window has been used to replace the usual glass window, as an additional factor of safety. A light has been incorporated in the boot to facilitate careful inspection of the part, and to assist in maintaining the optimal temperature within the boot. In addition, during treatment, the boot is raised above the level of the heart, as was suggested by Herrmann and Reid, and one arm is heated to insure maximal dilatation

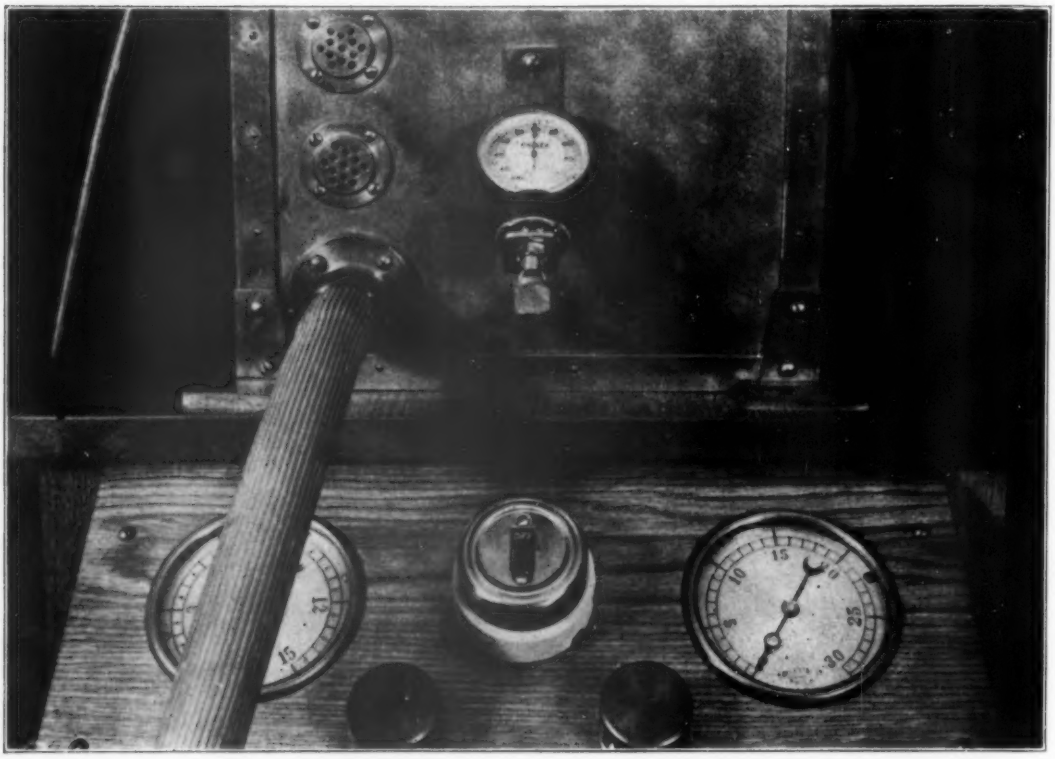

Fig. 6. — Panel board of machine and end of boot showing switch, positive and negative pressure gauges and relief valve controls. At the end of the boot are an additional gauge and safety relief valves.

of the capillaries, as was suggested by Gibbon and Landis.

My own clinical studies, to date, are insufficient to allow me to draw any conclusions. This modification of the Landis apparatus for passive vascular exercise is presented for consideration.

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SHORT WAVE THERAPY IN PYOGENIC SKIN INFECTIONS *

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NEW YORK

Short wave therapy is the term employed to designate the use of a high frequency current of 10 to 100 million frequencies, or wavelengths of 3 to 30 meters. There are two types of apparatus, the tube and the spark gap, for generating this current. Unfortunately, the apparatus is not yet standardized. Since neither the efficacy of the individual wavelengths nor the intensity can be exactly measured for clinical purposes, it is practical to use a machine with a 4 to 25 meter range. For pyogenic infections of the skin about 100 watts output has proved satisfactory.

The success of short wave therapy in these infections of the skin has been ascribed to several factors, chief among which is immediate marked vasodilatation. The increased circulation increases phagocytosis. Indirectly, there is an an antitoxic and bactericidal effect which assists the organism in combating infection.

Furuncle

Although as a rule most furuncles are cured by conservative treatment, there are cases with marked inflammation and subsequent abscess formation which require surgical intervention. It is in this type of case that ultrashort wave therapy has proved to be of especial benefit, as a simple and mild form of treatment.

In the past six years Schliephake has treated more than 500 cases of furuncle and furunculosis of variable severity. He reports only 2 failures attributable to the patients themselves. The cases were entirely unselected, just as met with in general practice. The average number of treatments required were two to six and the average duration until cure was effected was 4.6 days. Pflomm stated that short wave therapy produced cure at an average of six days, whereas the normal healing period under ordinary conditions is thirteen days. In the follow-up no recurrence was observed. Hoeffler and Weissenberg reported rapid cures with smaller doses also in children.

Schliephake, Raab and others noted that by treating only a few furuncles the remainder were apt to subside spontaneously. It was also found that chronic recurrent furunculosis was cured after treating periodically recurring furuncles, and a follow-up, in some cases of some months and in others of years, showed no recurrence.

They may lend support to the hypothesis that absorption from furuncles treated by short waves induces some sort of autovaccination which prevents recurrence. A number of investigators, including the present writer, favor this view. Schliephake believes that the dead and dying bacteria give rise to a form of autoinoculation. For example, in the case of furunculosis, one can observe a definite shrinking and regression of a whole group of smaller boils after treatment of a single large furuncle or carbuncle. For this reason it would seem advisable to subject furuncles with abscess formation to short wave therapy for a few days, even if surgical intervention is contemplated. This holds good also for the case of axillary abscesses.

In case of facial localization, especially on the lip and nose, ultrashort wave therapy without doubt gives the best results, since it lowers the mortality and lessens the risk of serious complications. The danger inherent in labial and nasal boils is well known. The infection may invade the cavernous sinus by way of the angular and the superior ophthalmic vein with fatal outcome. Because of the possibility of such a serious complication the tendency has been toward a conservative treatment, since the operative mortality has been given as between 5.5 and 30 per cent by different au-

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thors. For this reason ultrashort wave therapy proves to be an especially efficacious measure. Liebesny, out of a series of 81 cases of facial furunculosis, reported one death by meningitis, or 1.2 per cent. His cases were localized as follows: Lower lip, 7; upper lip, 30; nose, 24; chin, 14; forehead, 2; cheek, 4. In some cases the temperature, already high before treatment, rose to higher levels after the first short wave treatment and fell after the second and third. As a rule the inflammatory process was arrested and the pain usually decreased after the first treatment. The redness subsided and became demarcated after from two to four treatments. This was also the case in furuncles of the auditory canal. Although the lesion may not go on to suppuration, a relatively quick abscess formation was frequently observed. This evacuated spontaneously or through an incision best performed by electrosurgery. Where no distinct fluctuation was present short wave therapy alone was sufficient.

In the infiltrative stage the infiltration may soften and resorption may take place without discharge. The pain and tumor usually subside after the first or second treatment. After a few treatments the skin becomes loose and wrinkled and quick regression is observed. For a few days the skin may be a bluish or brownish-red gradually fading to normal, without tenderness or sensation of tension.

In those cases in which a core has developed surrounded by inflammation and with edema or abscess, in which surgery is usually resorted to, the throbbing pain and tension will subside after the first or second application of ultrashort wave therapy. After twelve to twenty-four hours demarcation of the inflammatory area is observed. The lesion acquires a dull bluish-brown color, gradual resolution of the edema follows with softening of the entire infiltrated area, abscess formation around the core is moderate and there is spontaneous elimination of the core accompanied by a small amount of purulent, seropurulent or serosanguineous discharge. With subsidence of the inflammatory process healing takes place at an average of two to five treatments in four to six days, and after the pathologic process is cured nothing remains but a small scab over what had been the necrotic focus.

In the case of furuncles of a more advanced stage which are already softened and abscess has formed, the pus is spontaneously evacuated after or during the first treatment and healing takes place with unusual rapidity in two or three days. In the severe cases healing is quicker if the affected parts of the body are immobilized until the inflammation distinctly subsides. In any case patients are not prevented from pursuing their usual occupations or routine of their daily lives. A few illustrative case reports from our material follow:

Case Reports

Case 1. — Furuncle of the Buttock. — The patient, female, 50 years of age, came for treatment on October 8th, 1934, stating that she had suffered from boils since June 15. Surgery had been resorted to several times and an anesthetic was required for the opening of one boil in the gluteal region. *Clinical Findings.* — A large furuncle of a week's duration was situated at the left border of the anal and gluteal region, and was so painful that it interfered with walking, sitting and sleep. The skin was red and edematous over an area 2 inches in diameter. In the center of the lesion was a small scab. On palpation the entire area was tender and infiltrated, and slightly fluctuant in its midportion. One treatment was given with the 6 meter wavelength for ten minutes followed the next day by a second treatment. There was decided subjective improvement and only slight pain. The area of infiltration was diminished and of a dark bluish-red. Three more treatments were given, with gradually diminishing inflammation and infiltration. A moderate amount of serous discharge necessitated a small dressing. Six days after the first treatment all that remained was a painless area of infiltration under a small scab. The patient was discharged cured. No further furuncles developed during the following six months. No recurrence was observed and a fine pin-point of scar indicated the site of the original lesion.

Case 2. — Furuncle of the Neck. — Dr. F., 63 years of age, presented a large furuncle on the left posterior side of the neck which had developed four days before. There was complaint of throbbing pain and tenderness radiating to the shoulder and occipital region. *Clinical Findings.* — The inflamed and infiltrated area was about 1½ inches in diameter. After the second seance with short wave therapy, using 6 meter wavelength for fifteen minutes, the subjective symptoms subsided. There was no pain although tenderness on palpation and motion continued. The inflammation became localized with central fluctuation and pointing. After the fourth treatment the core was extruded with a slight amount of pus. The lesion was slightly tender to touch and an area of infiltration about three-fourths of an inch in diameter remained. After two further treatments the infiltration and tenderness disappeared, and after a sixth only a bluish-red area about one inch in diameter circling a small

scab gave evidence of the former site of infection. The lesion healed completely in three weeks without surgical intervention and with a practically invisible scar. The healing in this case was unduly prolonged as the patient came for treatment spasmodically, discontinuing it whenever subjective relief had been obtained.

Case 3. — Furuncle of the Face. — A. B., female, 23 years of age, developed a painful furuncle three days after a pimple had been manipulated. The left side of the cheek had been swollen for a day and the patient was unable to speak or eat in a normal manner. The left chin area and cheek were swelled and red. Near the left angle of the mouth was an infiltrated area about one inch in diameter surrounded by an edematous area of about one and a half inches. From the center of the lesion pus exuded from a small sinus. Ultrashort wave therapy was given for fifteen minutes and the patient reported relief of pain six hours later. The next day the swelling had decidedly diminished, with a slight seropurulent discharge. After the second treatment on the third day the swelling had subsided completely. The inflammatory area was about three-fourths of an inch in diameter and there were no subjective symptoms. Altogether three treatments were given using the 6 meter wavelength for fifteen minutes and the patient was discharged. The pathologic process subsided in five days leaving first a reddened area which cleared in a few days, and finally only a scar about one mm. in size remained.

Case 4. — Furuncle of the Right Lower Arm. — T. W., boy, 11 years of age, had undergone splenectomy three years before for thrombocytopenic purpura and gave a history of having had fifteen transfusions on different occasions to control bleeding. *Clinical Findings.* — There was a painful tumefaction on the right lower arm of two days duration. The proximal radial third of the lower arm was red and edematous over an area about two inches in diameter. The area of infiltration, about one inch, had a bluish hue with the core showing in the center as a small yellow point. There was tenderness to palpation but no fluctuation could be detected. Because of the history of purpura operation was considered inadvisable. A first treatment with the 6 meter wavelength for fifteen minutes was given and on the following day the edema and inflammation were considerably diminished and, although tenderness to touch was still present, the pain had subsided. The lesion was discharging and about 1 cc. of sanguineous pus could be obtained by gentle pressure followed by moderate bleeding. A second treatment was given and on the third day there was no further pain with only slight edema and localized inflammation around the discharging sinuses. An ecchymotic ring about one and a half inches in diameter was noted around the lesion. A third treatment was given and two days later there were no signs of inflammation and only a slight area of painless infiltration topped by a small scab. The ecchymosis gradually faded. Cure was accomplished within four days with three treatments.

Case 5. — Furuncle of the Sacral Region. — G. M., female, 61 years of age, a diabetic, presented a furuncle on the lower back of five weeks duration. It had discharged periodically and had grown more extensive. The patient was unable to lie in bed because of pain. Inspection revealed a red infiltrated area about the size of an apple, not discharging, but tender to touch. Following the first two treatments with short waves the lesion became smaller and softer and less tender to touch. Fluctuation was absent, but there was a very slight serous discharge. Two more treatments were given with the 6 meter wavelength for fifteen minutes each, and these effected a complete cure. The only lesion remaining was a small area of painless infiltration with a small scab in the center. There were no recurrences.

Case 6. — Furuncle and Abscess of the Axillary Region. — G. S., 27 years of age, complained of throbbing pain of four days' duration in the right axilla where, three days before, a furuncle appeared on the lateral chest wall. In the axilla there were two areas of inflammation and induration measuring about an inch in diameter and exuding pus from the core. The first short wave treatment with the 12 meter wavelength for fifteen minutes was directed to the axilla and the furuncle. The axillary abscess softened and following two more treatments discharged spontaneously. Pain decreased after the first treatment and disappeared after the second. The edema decreased and induration diminished after two treatments of the furuncle. Discharge stopped on the third day and resolution was complete on the fifth. The axillary abscesses, after discharging a small amount of seropurulent material, decreased in size and diminished in inflammation after three days. Cure was complete in six days and no recurrence has taken place within a year.

These selected cases give a clear picture of the effectiveness of short wave therapy in promoting healing of furuncles. We gain the impression that the conservative treatment of furuncles with the aid of short waves is a decided advance over methods hitherto employed. It is a simple method with no attendant dangers and in most cases renders surgery unnecessary. Nevertheless, in appropriate cases it may be necessary to make a small incision in order to hasten the healing process and facilitate evacuation. In our 37 cases of furuncle it was necessary to incise only twice. These were instances in which abscess formation was present which inconvenienced the patient by its size or location. When surgery is employed its conjunction with short wave therapy shortens the time of recovery.

Carbuncle

The von Seemen treatment of extensive and severe carbuncles destroys the infection through electrocoagulation. This leaves a clean granulating surface after seven to twelve days which is ready for plastic pro-

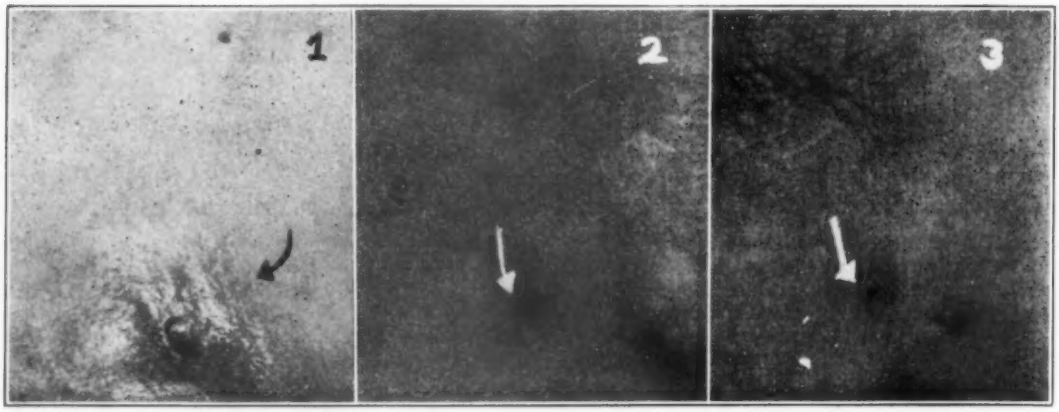

Fig. 1. — Reading from left to right: 1, Furuncle of the chest wall; 2, Furuncle of the chest wall three days after short wave treatment; 3, Furuncle of the chest wall five days after short wave treatment.

cedures of skin transplantation. The treatment of carbuncles with short waves is a simpler and milder method, shortening the duration of the affection and causing fewer complications if instituted in time, as evidenced by a statistical survey of the literature.

In the early stages when only infiltration with tenderness is present resolution may take place, as in the case of a furuncle, after from three to five treatments. But where extensive necrosis is evident the wound clears after an average of six to eight applications and is then covered with fresh healthy granulations. It goes without saying that where fascia and muscle are involved the healing period is longer, even though distinctly shortened as compared with the course under other forms of treatment.

Scar formation takes place quickly owing to the stimulation of biologic processes by this form of therapy. This therapeutic agent is especially recommended for use in diabetic patients. Raab describes a man 72 years of age, with a carbuncle on the neck which measured four by six inches in diameter. This case was treated unsuccessfully with light therapy, protein injections and other measures. The temperature was 102 degrees F. and the patient was in an unsatisfactory general condition. After the second treatment with short waves the lesion began to regress, became softer, and after 14 sessions clear healthy granulations with subsequent cure ensued. Raab believes that in this case short wave therapy was a life-saving measure.

Certainly there are cases in which it is wiser to combine surgery with the ultrashort waves in order to hasten healing. Two cases from our own material illustrate this point:

Case 1. — A young man, 28 years of age, gave a history of suffering for six days from a carbuncle two and a half inches in diameter situated on the neck. The patient's average temperature was 99.9 degrees F. On November 10, 1934, the first short wave treatment was given after which the patient's temperature returned to normal and he felt comfortable. Two days later an abscess was formed with distinct fluctuation but not markedly tender. As resorption could not be expected an incision one-half cm. long was made by means of the electrocoagulating current. About 10 cc. of pus was gently expressed. Culture showed staphylococci. Two days later the patient had no pain or discomfort. At the incision was a small granulating wound with slight serous discharge. The patient was discharged next day after four short wave treatments, the lesion showing a small area of infiltration covered with a dry scab over the site of the incision. Examination twelve days after the beginning of the treatment showed that complete healing had been effected.

Case 2. — A man, 45 years of age, with a furuncle and carbuncle of the neck, gave a history of having suffered for three months from the lesions in this locality. He had been operated upon several times for these periodically recurring infections. The carbuncle present about two weeks, caused him much suffering. It presented an infiltrated red area with edema about two inches in diameter with several yellow cores in the central portion. The urine was free from sugar. Two short wave treatments in two days were given, with improvement of the subjective symptoms. Daily treatments were continued with further local and general improvement. After the fifth treatment the lesion was no longer discharging and the reddened area of infiltration was reduced to one-half inch and no longer tender. The lesion was entirely healed in seven days. The treatments were

ten to twenty minutes in duration, using the 12 meter wavelength. Five days after his discharge the patient returned with an inflamed area on the chest two and a half inches in size, slight elevation of temperature and in general suggesting a new streptococcus infection about the right breast. This lesion was cleared and healed in four days under short wave therapy. While this lesion was under treatment a fresh lesion appeared on the neck at the site of a scar from a former surgical intrevention. It became swollen and very tender. After two treatments it opened spontaneously evacuating about 1 cc. of purulent discharge. The next day there was an abscess with distinct fluctuation in this area and lymphadenitis on the corresponding side of the neck. This patient developed a subfascial abscess which gave him a great deal of discomfort. A 1 cm. electrosurgical incision was made with the coagulating current. Without further drainage this resulted in the evacuation of 5 cc. of sanguinopurulent material. Treatment for six days with short waves resulted in cure. The lymphadenitis subsided after two treatments. Three other cases healed readily in ten to fifteen days with short wave therapy and without surgical intervention.

Pain is quickly relieved after two or three treatments, as a rule. In Liebesny's fifteen cases of carbuncle of the neck, cure took place between eight and fourteen days. Schliephake, on the basis of a very large series, found that even extensive carbuncles heal in ten to twenty days after eight to fifteen treatments without surgical intervention.

Lob observed increased inflammation of the treated carbuncles with aggravation of the condition, which was attributed by Schliephake and Weissenberg to over-treatment. Lob also believes that short wave therapy should not be employed in acute surgical infections, in fact, that the measure may be dangerous. He compares the action of short waves to hyperemic treatment of pyogenic infections and that, as such, the treatment may result in increased exudation. Through the increased tissue tension within, the bacteria and toxins may penetrate to the adjacent deeper tissues. He believes, therefore, that it is important to open widely and to drain the diseased area.

Cases may be observed in which overdosage or insufficient treatment result in an aggravation of the condition. Overdosage occurs easily when the protective powers of the surrounding tissues are destroyed. Hence, instead of supporting the organism short waves, in such instances, may become destructive. After a survey of reported cases, however, such aggravation clearly could not be attributed to the short wave therapy. Also, there are unquestionably cases in which proper surgical drainage is indicated in conjunction with short wave therapy. It is therefore desirable to employ short waves only under proper supervision to decide the time for intervention.

It should be noted that the treated area will often show an increased redness after the first or second treatment, giving a picture of "increased inflammation" which is only apparent, and not actual. The patient's subjective symptoms are improved even when a rise in temperature for a day is observed.

Judging by reported results in the literature and by our own cases, the treatment of carbuncles by short waves impresses us as being eminently satisfactory. It is a mild conservative form of treatment giving quick, comfortable resolution of the lesion, even in cases of diabetes in which it is particularly indicated.

Nevertheless, in certain cases after a deep abscess has formed, drainage hastens the healing process and to this end a small incision should be made, preferably by electrosurgery while continuing short wave therapy. The healing of the lesion after short wave therapy is very satisfactory from a cosmetic point of view, as only small points of scars remain where the cores were situated. The choice of cases for surgical intervention is a matter of judgment and experience.

Diverse Infections

Axillary Sweat Gland Infection and Abscesses. Pyogenic infection of the axillary sweat glands is obstinate to treatment. Many measures are employed, cure eventually following surgery or some physical therapeutic agent. Roentgenotherapy and vaccines have also been used with success. In complicated cases recurrences are common.

Since the advent of short wave therapy this form of treatment has been acknowledged to be superior to any other form of treatment. Early infiltration is resorbed after three to five treatments. If abscesses have formed one to three treatments may be followed by spontaneous evacuation with quick healing. Tenderness usually subsides after the first or second treatment, the inflamed areas decrease in

extent and become limited. Sometimes there is distinct shrinkage of the skin over the lesion. In other cases swelling may be increased and tenderness become more acute until spontaneous rupture occurs. Some patients, more sensitive than others, cannot bear pain well. In such, opening of the abscess may be advisable with intracutaneous novocain anesthesia in the incision line, using high frequency cutting (coagulotomy) or the cautery for drainage, in combination with short waves.

Electrosurgical incision or electrocautery incision of abscesses is advised, first, to prevent dissemination of the infection in the surrounding tissues. A second reason is that the wound edges are thus covered with a film of coagulated tissue. Granulation being delayed in this manner the wound remains open until the abscess is discharged. The slower healing of the wound edges prevents untimely closure and clogging. Short wave therapy should be continued until complete healing takes place in order to preclude recurrence. This is assured when no infiltration or pathologic changes are present. Scar formation is almost avoided by this form of treatment.

Estimates by various authors give a healing time by short wave therapy fifty per cent faster than by other methods. Healing depends to some extent upon the stage and severity of the lesion, but usually it takes place within three to fourteen days after from two to ten treatments. Rarely fourteen to twenty-one days are necessary for a cure. Immobilization of the arm shortens convalescence. Liebesny reported a series of 26 cases in which fourteen to twenty-one days were required for cure. Recurrences are rarely observed.

Erysipelas. Short wave therapy has proved to be a remarkably effiicacious addition to the treatment of erysipelas. In the early stages and if no ulcerations are present, cure may be obtained after one or two treatments (Schliephake, Raab, Sweitzer, Pflomm). The grave gangrenous form is also greatly benefited and a quick favorable outcome may take place. The severity of the infection determines the number of treatments. In severe cases two treatments may have to be given daily.

In a case with septic temperature Weissenberg effected a cure in three weeks. This concerned a physician who had injured his finger in the course of his work, followed two days later by diffuse edema of the entire arm, and accompanied by intense pain. Daily treatments were administered for thirty minutes each at different areas of the diseased arm. The infection became localized and an abscess formed in the axilla, where it drained. The impression was gained that the institution of short wave therapy prevented the development of general sepsis, and caused the favorable outcome.

Erysipeloid. Infective dermatitis resembling erysipelas appears usually on the hands and responds readily to various therapeutic agents. Lob observed the disappearance of symptoms after a few treatments by ultrashort waves, followed by cure. The lesions are covered with the electrodes and daily treatments lasting fifteen to twenty-five minutes are given.

Technic

Furuncles. The method of applying the current for furuncles is relatively simple. The electrode should cover the lesion and the surrounding inflamed area. In order to obtain the best electric field for curative purposes electrodes of different sizes may be used, a smaller one on the lesion and a larger for the opposite pole. This will result in greater concentration of the electric field in the affected area. In the treatment of furuncles the Tomberg unipolar application might also be usefully employed.

If the lesion is situated on anatomically prominent parts, for example, the tip of the nose, rigidly fixed electrodes with proper air spacing may be used to advantage.

All the wavelengths within the range of ultrashort waves may be successfully used. Schliephake, Raab, Last and the writer prefer the 6 meter wavelength, or the 12 to 16 meter wavelengths. Schliephake and other investigators believe that the 8 to 12 meter wavelengths are not as effective.

If the technic has been faulty, for example, if too strong a current has been employed to obtain a marked heat effect, a mild degree of heat coagulation of the superficial cutaneous layers may occur. This is characterized by a bluish-red discoloration of the area surrounding the furuncle. In such an event healing is prolonged to eight or ten days without, however, any deleterious effects.

If there is a concomitant lymphangitis

this will regress simultaneously with the healing process in the main focus of infection. In an accompanying regional lymphadenitis is will also yield to the short wave therapy directed to the involved area. If the affected glands are near the principal lesion, the cure of both may be accomplished in a single operation.

There appear to be no contraindications. Patients treated with short waves do not exhibit marked secondary effects. On the other hand, the method is definitely indicated in cases in which surgery is not free of risk, as in diabetes, or in hemophilia.

Carbuncles. The technic is the same for furuncles. It is a good plan to cover the entire inflamed area with one of the electrodes and to prolong the time of exposure to fifteen to twenty-five or thirty minutes daily. Two different electrodes should be used, the smaller one covering the diseased area with the larger one on the opposite side of the body. The electrodes can be placed on the head without harmful effect. Greater concentration in the electric field in the diseased area may also be obtained by approaching the electrode closer to the surface of the diseased area than on the opposite side. The Tomberg method of unipolar application can also be used. It is important to obtain an even irradiation with stronger doses than in furuncles. The more severe the condition, the longer the irradiation should be, but it should by no means exceed twenty or thirty minutes. Usually five to eight treatments of fifteen to twenty minutes daily will suffice to bring about healing. The recommended wavelengths, as suggested by different investigators, are 4, 6, 8 and 12 meters.

In large carbuncles progress is less rapid but resolution invariably takes place and the temperature subsides to normal after a few treatments.

Axillary Sweat Gland Infections. Special electrodes, on the same principles as those employed for furuncles and carbuncles, are used for axillary abscesses. When both axillae are affected the electrodes may be placed in both. The time of application varies from ten to thirty minutes, depending upon the character of the lesion.

Capaldi found that only the 8 meter wave gave good results. It proved effective in one case in which the 4 and 15 meter waves had been without effect. He stresses the fact that the 4 and 15 meter waves generated more heat than the 8 meter wave and draws the conclusion that the benefit in the latter does not rest in its heating effect. We cannot agree with this observation, since we obtained our best results with 6, 12 and 14 meter wavelengths. We are under the impression that in superficial infections, such as axillary abscesses, the wavelength is not of primary importance.

Erysipelas. The preferred wavelengths are those of the short range — 4, 6, 8 meters — and the duration of treatment is from fifteen to thirty-five minutes each.

Short wave therapy in pyogenic infections of the skin is justified and the results of this conservative form of treatment are promising.

With improper technic superficial burns are sometimes, though rarely, observed. These can easily be avoided by properly instructing the patient and paying attention to appropriate air spacing of the electrodes. The principal cause of burns is perspiration, therefore patients who perspire freely should be treated with care. Among the 300 cases which we have treated we have observed only two small burns, and these healed without deleterious results.

Conclusions

Short wave therapy is a valuable adjunct to the management of pyogenic skin infections. In the great majority of cases surgical intervention becomes unnecessary, the clinical course is noticeably abbreviated, and the treatment terminates with good cosmetic results.

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ANALYSIS OF SELECTIVE EFFECTS OF SHORT WAVE THERAPY *

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Many of the recent reports on the subject of short and ultrashort wave therapy describe specific electric effects and specific bactericidal action. Experiments which are reported are frequently diametrically opposite in their results. The object of this paper is to analyze some of the results and to explain them on a physical basis, to indicate why some experiments may have been successful and others unsuccessful, to present concisely the relationship between the physical quantities which will enable us to predict specific electric action and to interpret the effects which we observe.

Before discussing the specific effects we will consider first the mechanism by which heat is produced by the action of a high frequency field. An ultrahigh frequency field is essentially an electromagnetic field; the lines of electric potential are usually found to be at right angles to the force lines of magnetic potential, and both of these are generally at right angles to the direction of propagation. However, in the practice of high frequency therapy, it is customary to use only one of these fields for the production of heat, i.e., either the electric field or the magnetic field. Actually we never find one field completely divorced from the other, we may however, for a practical analysis consider them separately.

Apparatus which use the magnetic field employ a loop or coil of cable as the applicator. The heat is generated by the Foucault or eddy currents which are induced within the tissues due to the interception of the lines of magnetic induction. This induced current that is generated within the body, in overcoming the resistance produces heat in much the same manner as if the current were introduced directly. These currents produce heat in accordance to Joule's Law. Within the frequency range that satisfactory induction takes place the so-called selective or specific action is not pronounced.

Most common today are the machines which use the electric field as the medium for heat production. Almost all of the specific effects are reported from experiments in which the electric or condenser field has been used. This field lends itself more readily to short and ultrashort wave application than does the

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magnetic field. This paper is limited to a discussion of results from apparatus that essentially make use of this type of field.

Heat is generated in a high frequency electric field by nature of a phenomenon known as dielectric hysteresis. A dielectric is nothing more nor less than a substance in which the electric field exists. Highly conducting bodies are hence excluded from being dielectrics, for when placed in the electric field they assume a single-valued potential which is essentially uniform throughout the conductor and consequently no field can exist within the conductor.

The atomic particles of which a body is composed, when placed in an electric field become stressed and distorted, i.e., elongated in the direction of the field. The explanation of this is that the atoms themselves are composed of plus and minus charges of electricity: protons and electrons respectively. The protons tend to travel toward the negative part of the field and the electrons toward the positive part, according to the principle of unlike attracting and like repelling. In this stressed condition the atoms may be said to be polarized, i.e., they exhibit the properties of a charged body. From observation of macroscopic polarized bodies in an electric field it is easy to visualize the action of the microscopic particles.

The particles tend to align themselves in the direction of the field, thus if the field is reversed, the particles will tend to turn around and reverse their direction. If the field oscillates in polarity the particles will also tend to oscillate, turning first in one direction and then in the other, at all times trying to follow the direction of the field. Naturally in solids and liquids any motion is somewhat constrained by the close proximity of adjacent atomic particles, hence we may expect some resistance to any motion and resultant friction between the particles.

For purpose of a physical picture we may consider heat as being generated by this internal friction. In any individual reversal of the field the amount of heat generated may be very infinitesimal. When we consider that in the high frequency apparatus with radio tubes the field reverses several million times a second, it is no wonder that large quantities of heat can be generated.

This phenomenon is called dielectric hysteresis and may be likened to the more familiar one of magnetic hysteresis. It is always dangerous to give analogies for they are invariably taken for more than they are intended; however, permit us to be bold enough to offer a homely one. Electrically the difference between diathermy and short wave therapy, outside of the difference in the wavelengths of the two, is that diathermy uses a conduction current and heats primarily according to Joule's law, whereas the short wave apparatus uses only a capacitative current and heats by virtue of the losses in the dielectric hysteresis. Imagine a slab of rubber clamped at each end, let these clamps move backward and forward rapidly stretching and relaxing the rubber. If this is done fast enough we will notice that the rubber becomes materially warm also if we cut the rubber we find that it is warm throughout. If we can visualize the internal friction between the rubber molecules we have a rough picture of the manner in which dielectric hysteresis functions. Replace now this block with one containing a lot of holes, in these holes pass cords and place the ends of the cords in the clamps, hold the block of rubber still and allow the cords to pass in and out of the rubber. The friction of the rubber on the cords will soon heat the rubber and we will notice that the rubber is particularly hot in the part adjacent to the cords. Considering these cords as the diathermy current we have a rough analogy to the two types of heating.

Several theoretical determinations have been made concerning the relationship of the factors which control the amount of heat produced within a substance. The results have been proved experimentally by McLennan and Burton, and others.[1, 2, 3] The amount of heat depends upon several factors. It depends upon intensity of the electric field, the geometric configuration and location in the field of the dielectric substance, the dielectric constant and that of the surrounding medium, and the high frequency resistance of the substances. It has been shown theoretically and checked by experiment that for a given wavelength there exists a particular value of resistance for which the heat generated will be a maximum (other things being constant). Perhaps it would be more accurate to state that for a given wavelength and a *given dielectric constant* there exists this particular value of resistance for which the substance will be heat-

ed most. The quantities are related as expressed below:

$$\frac{\lambda}{c} = \frac{\epsilon}{2\kappa}$$

λ = wavelength in meters
c = velocity of light
= 300,000,000 m/sec.
ϵ = dielectric constant
κ = specific conductivity.

We may use this relationship to determine the wavelength which will give us maximum heating for a given tissue or fluid. We only need to know or be able to determine the high frequency resistance and dielectric constant. Many of these have already been determined.[4, 5] As an illustration let us consider blood. We find that for the serum the constants are: $\epsilon = 85.5$ and the specific conductivity $\kappa = 110 \times 10^{-4}\ \omega^{-1}$. For the proteins $\epsilon = 85.0$ and the specific conductivity $\kappa = 10 \times 10^{-4}\ \omega^{-1}$. Applying our formula we find that 1.3 meters will favor the heating of the serum and that 14 meters will favor the heating of the remaining proteins.

Similarly if we determine the specific conductivity and dielectric constant for any given bacteria, we may by the use of this formula determine which frequency will give us the most specific heating effect. This relationship is all important and is the keynote to the whole explanation of the selective effects of short wave therapy. The experiment of Esau where alkalinized water and a mixture of paraffin oil are exposed to a high frequency field which resulted in the production of steam with the temperature of the mixture only about 65 degrees C. shows very markedly the manifestation of this selective action. This effect is sometimes called "point heating," the most heat being generated at those points of suspension of the water in the solution.

Schliephake, Liebesny, Groag, Tomberg, and others have shown that bacterial cultures exposed to short wave fields react to specific wavelengths. With some wavelengths the cultures will be weakened or destroyed, whereas similar cultures exposed to other wavelengths will be only slightly affected if at all. The bacteria may be destroyed while the temperature of the medium which surrounds them may be many degrees below their thermal death point. This may be explained by the above equation. The ratio of the dielectric constant to the specific conductivity was such that for the specific wavelength the bacteria were heated much higher than the surrounding medium which had a different ratio of ϵ to κ. Hence it was possible for the bacteria to reach their thermal death point while the medium remained several degrees lower in temperature.

Frequently we are confronted with reports of opposite results for certain bacteria and specific wavelengths. Apparently both investigators are careful and observant, but yet the reports are in direct opposition. It is important to notice what medium of the culture is used and how it is suspended in the field. The medium must be chosen not only with regard to its quality as a bacterial medium but must also have the correct electric qualities. In general the most satisfactory medium is one with very high resistance and low dielectric constant. A medium with low resistance or high dielectric constant will act like a shield and reduce the field strength within the bacteria to a point where little or no action results.

It is highly important to place the patient in the field so that the most good will be accomplished. Many who condemn short wave machines as ineffective are themselves to blame. Good technic is as important as a good apparatus.

For example, we have found that in over fifty cases of shin splints (modified hypertrophic tendo-vaginitis) best results were obtained when one pad was placed under the foot and the other over the knee. Almost no results at all were obtained by treatment with the pads to either side of the leg. Let us see if we can find some physical explanation for this. If for purpose of calculation we consider the limb to be an elongated ellipsoid and assume a dielectric constant of 80 (a fair approximation for this type of tissue), and that our field is uniform (it will approximate this condition if we space our pads sufficiently) and the ellipsoid is placed the long way of the field, we find that the intensity within the ellipsoid will be nearly that of the field. If we now place it at right angles to the field, as is the situation when we are treating with the pads at either side of the leg, we find that the field strength within the ellipsoid in only 1/40 of what it was before. It is little wonder then, that the results were so poor in the latter case.. Incidentally it was found that 11 meters was the most satisfactory wavelength for these cases.

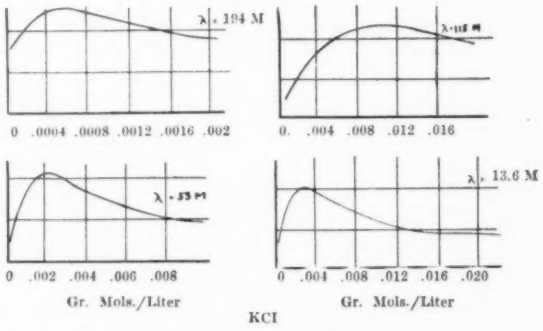
In the treatment of live tissue the specific heating action is not so pronounced as in that of dead tissue or cultures. The circulation in live tissue tends to equalize any large thermal differences. If the temperature of any one place in the body is raised, the circulation is automatically increased and consequently the thermal equalization is speeded.

If we wish to obtain more pronounced specific heating effects, we must generate the heat rapidly, i.e., use very powerful apparatus which produces a very intense field. Thus the heat is generated quickly and will be able to raise the temperature appreciably before thermal equilibrium takes place. If the heat is generated slowly, the thermal redistribution may take place about as fast as the heat is generated, and we will be able to observe only a small differential elevation in temperature. However, by supplying a large quantity of heat all at once, we may be able to effect a large temperature difference before the heat has a chance to be dissipated. Incidently this may explain why some of the American investigators have been unable to duplicate some of the results obtained by the European experimenters. Very few of the American apparatus compare in power with the European types, particularly the ultrashort ones.

An experiment was performed in which the medium was chilled and the bacteria exposed to a rather strong field. This was followed by placing the same bacteria in a heated medium (a few degrees below the thermal death point) and exposing to a comparatively weak field. The result was that the chilled cultures produced a luxuriant growth but the warmed ones only a few scattered colonies. This may be interpreted as indicative of the *heating action* being the *active* function and not any specific electric effect, for in the chilled medium the bacteria were in a strong field but their surroundings kept them from getting very warm, while in the warm medium it only required the addition of a little heat to bring them to their thermal death point. Also, it is interesting to note that wavelengths varying considerably from 12 meters produced little or no effect, on both tests, the results being the same as those of the controls which were not irradiated.

We do not have sufficient evidence to state dogmatically that there are no specific bactericidal effects of short and ultrashort waves, but we do have sufficient evidence to explain practically all of the observed phenomena on a purely physical basis of selective heating action. The electrical characteristics rather than the organic, determine the selective response of a substance to an electric high frequency field. This phenomenon of preferential heating provides us with a very satisfactory explanation, and there is certainly no necessity to enter into complicated hypotheses and attribute any mysterious properties to short waves in order to explain this selective action.

The phenomenon of *point heating* enables us to raise bacteria to their thermal death point, without appreciably raising the temperature of the surrounding medium. Also we



Curves showing the selective effect from studies on pure electrolytes, curves decreasing directly with wavelength.

may find within the body cases in which the point action on the bacteria is slight, but that they respond nevertheless. This might be explained by the fact that the surrounding medium or bacteria end products are of such an electric constitution that this surrounding medium is raised to a high temperature, whereas the rest of the body may not be heated excessively. It is needless to point out that in the living body the lymphatic migration and phagocytosis play a most important rôle. We are merely attempting to point out specific effects, the above being of course common to almost all therapeutic wavelengths.

To strengthen the contention that specific effects are directly explainable by the preferential heating phenomena, it is pointed out that the same theory explains the more pronounced selective effects for the short wavelengths. It has been observed that the shorter wavelengths are more selective; it can also be shown from the purely electric standpoint that we would expect this. The curves shown were taken from data on pure electrolytes

and establish the greater selective effect as the wavelength is decreased. Furthermore these curves do not change their shape for other substances but depend essentially on the electric properties as is shown in the second set of curves.

Conclusion

Short wave apparatus using the electric field, heat by means of a phenomenon known as *dielectric hysteresis*. The intensity of the heat produced depends upon the field strength, frequency, dielectric constant and specific conductivity. There exists for each combination of wavelength and dielectric constant a particular resistance for which the heating will be a maximum. This may also be stated that for a given ratio of dielectric constant and specific resistance there is a certain wavelength which will favor the heating of substance.

Practically all of the so-called specific electric effects can be explained by this preferential heating. Point heating is merely another form of heating and may be used to explain other selective effects on bacteria. The use of a medium with undesirable electric characteristics may be responsible for many negative results with cultures exposed to high frequency fields.

In order to secure maximum selective effects a very powerful field should be used to minimize thermal distribution. A probable explanation of the negative results American investigators have had, may be in the use of too small a power to obtain high thermal selectivity. Selective effects are more pronounced with the ultrashort waves, as has been observed *in vitro*, experimentally and analytically.

Only with more research and more determinations of the dielectric constant and specific resistivity of a greater number of substances, and particularly the investigation of the electric properties of bacteria will we begin to touch upon the tremendous possibilities of selective short wave therapy.

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A NEW TYPE OF VAGINAL RADIUM APPLICATOR *

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Since 1932, The Radium Institute of London has used a type of vaginal radium applicator in treating uterine cervical malignancy that apparently has not been described in this country. The advantages of this type of applicator are so apparent that we are sure it would be used much more frequently if called to the attention of those using radium in treating cervical cancer.

The technic of treating uterine cervical cancer at The Radium Institute of London is a modification of the methods used at Stockholm and Paris, that is, multiple centers of heavily filtered radium, small amounts in each center, and used over a comparatively long treatment period.

One of the types of vaginal applicators used is the object of this brief report. These consist of cylindrical bakelite capsules with rounded ends. They are about 15x28 mm. in diameter with 5 mm. walls, containing a platinum capsule with a 1.5 mm. wall thickness in which 15 millicuries of radon are placed. These applicators are inserted by means of long holders about 8 inches long which screw into the side of the bakelite capsule; they are placed and held in proper position by means of the holder. The vagina is then packed and the holders are not unscrewed and removed until the pack-

* Presented before the St. Mary's Hospital Clinical Conference, Jan. 4, 1935, Quincy, Illinois.

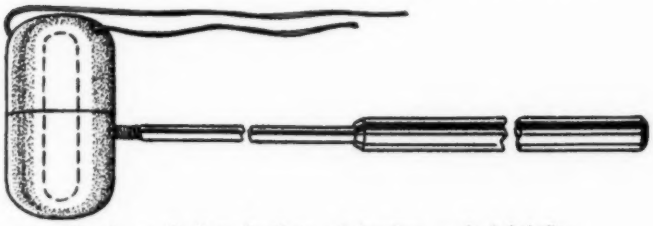

Fig. 1. — Radium Institute of London, vaginal bakelite, radium applicator, together with holder for placing same. (Actual size.)

ing of the vagina is complete. Usually three or four of these vaginal applicators are used, in addition to the intra-uterine applicator, when treating uterine cancer.

The capacity and formation of the cervix and vaginal fornices present so many variations that it is impossible to use a single applicator adequately to treat all cases. The advantages of this new applicator are: 1, the ends are so rounded that the applicators can be comfortably placed and the pressure on the vaginal mucous membrane evenly distributed; 2, the wall thickness of the bakelite is sufficient to form a secondary screen which permits of a large radium dosage within the limits of tissue tolerance; 3, as many applicators can be used as the size of the part will permit;

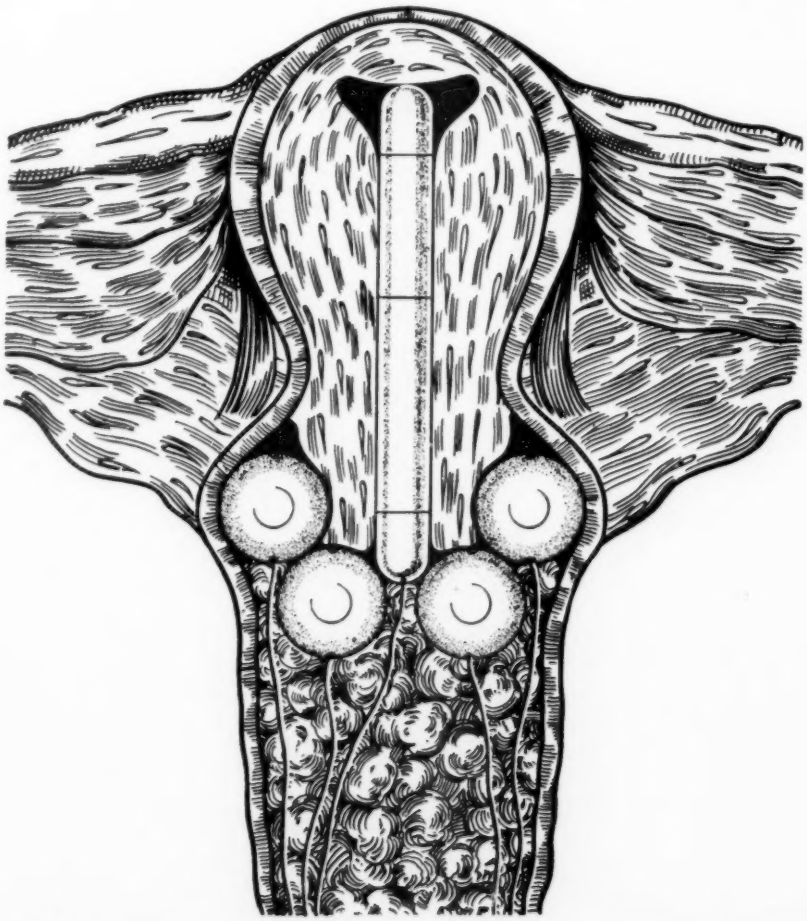

Fig. 2. — The author's adjustable uterine radium applicator, (without vaginal cross-arm piece) occupying the entire length of the uterine canal, and four of the London vaginal radium applicators in the vaginal vault, as used in treating carcinoma of the uterine cervix.

4, the applicators can be inserted with ease and correctly placed by means of the holders; and 5, by holding the applicators in accurate position by means of the holder while the vaginal pack is placed, the applicators are sure to remain in correct position during the treatment.

The writer has been using this new type of vaginal applicator for some months and has found it more convenient than any other type used heretofore. For over seven years I have used colpostats of various types modeled after the Curie colpostat of the Radium Institute of Paris, but often these are difficult of proper application and impossible for use if the vaginal vault is small. The Radium Institute of London vaginal applicator, because of the ease and accuracy with which it can be placed, is an advance in the technic of radium therapy as applied to uterine and vaginal cancer.

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RANGE OF PENETRATION OF DIFFERENT RAY QUALITIES IN RADIATION THERAPY *

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The quality range of a beam of x-rays varies widely in pentrating power. Experimental evidence has shown that some x-rays are able to penetrate only a few millimeters of air at atmospheric pressure, while others have been detected at a distance of 300 feet or more.

It is also established by experimental evidence that a spectrum of x-rays is generated containing a wide range of qualities or wavelengths with either a constant or pulsating exciting voltage. An x-ray spectrum can be represented by experimental data, (fig. 1). Voltages ranging from 20 K. V. to 50 K. V. were applied to the target and the spectra determined for 20, 25, 30, 35, 40 and 50 K. V. As the exciting voltage is increased from 20 to 50 K. V., the minimum wavelength is decreased from 0.63 to 0.26 angstrom units (1 angstrom unit equals 0.000,000,01, or 1×10^{-8} cm.). In addition to the displacement for the shorter wavelengths with increased voltage, there is also a marked increase in the intensity for all wavelengths.

The spectra for high voltage radiation, (fig. 2), give a minimum wavelength of .073 A. U. (Angstrom Units). The x-ray spectra of Figures 1 and 2 show that as the voltage increases, the minimum wavelength decreases.

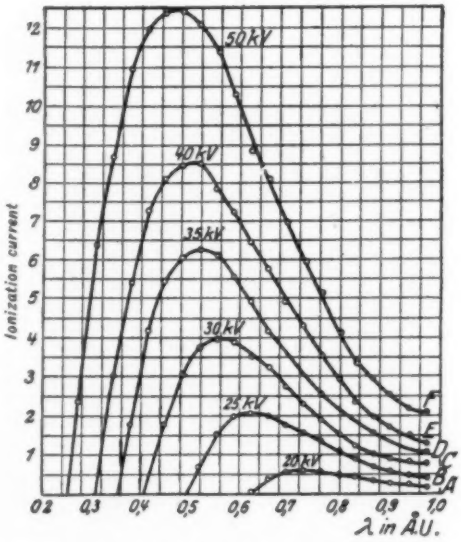

Fig. 1. — Intensity distribution of the continuous radiation from a tungsten target at various exciting voltages. (Ulrey)(1)

During the last four years, x-ray equipment has been developed to operate at 500 to 1,000 K. V. The spectra of radiation from such installations show a still further reduction of the minimum wavelength. It is estimated that voltages approximating 1,500 K. V. are required to give x-rays equivalent to gamma radiation. Therefore, it is seen that the quality of radiation is a function of the voltage applied to the target of the x-ray tube.

* Read at the Thirteenth Annual Session of the American Congress of Physical Therapy, Philadelphia, September 10, 1934.

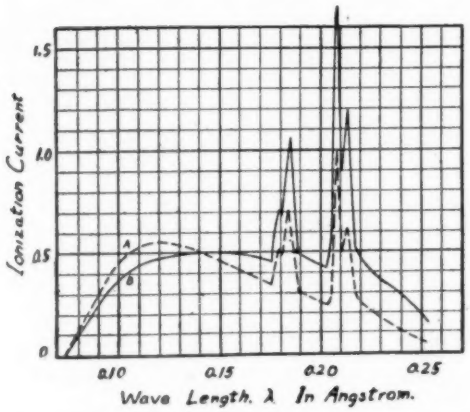

Fig. 2. — High voltage tungsten spectra. (Duane).(2)

Curves A and B, (fig. 2) give the spectra for high voltage radiation filtered by 1 mm. cu. and 12 mm. al., respectively. Curve A is higher than Curve B at the short wavelength end of the spectra and lower for the longer wavelengths. This fact demonstrates that aluminum becomes proportionately more opaque to the shorter wavelengths than copper. Since the penetration of radiation into the tissue, or some phantom representing the tissue, increases with a decreased average wavelength, it becomes necessary to find a filter allowing the maximum quantity of short wavelength radiation to reach the patient. Copper is most universally used as a filter, however some are now using a Thoraeus filter which is made up of tin, copper and aluminum.

A filter removes from the beam of x-rays a percentage of the short wavelength end of the spectrum as well as the longer wavelengths and beyond a certain wavelength the radiation is totally absorbed. The part of the spectrum entirely removed will depend upon the thickness and quality of the filter. As the thickness of the filter is increased, the spectrum of the beam of x-rays becomes more and more homogeneous in short wavelength radiation. Since the intensity of all short wavelength radiation is reduced by the use of a filter, the thickness of the filter cannot be increased beyond a practical limit. If more filtration is desired, it is necessary to increase the exciting voltage, thereby producing radiation of a shorter minimum wavelength.

The maximum practical filter for radiation excited by 130 K. V. is 1/4 mm. cu. or 6 mm. al. — by 200 K. V. is 2 mm. cu. — 300 K. V. is 3 mm. cu. — and 700 K. V. is 5 to 6 mm. cu. — or the equivalent in lead.

Effect of Scattered X-Rays

As radiation penetrates tissue, the rays scatter in all directions, similar to light radiation scattering in a fog. As the radiation penetrates deeper into the tissue, the wavelengths become longer, until totally absorbed. This is due to the "Compton Effect" (fig. 3).

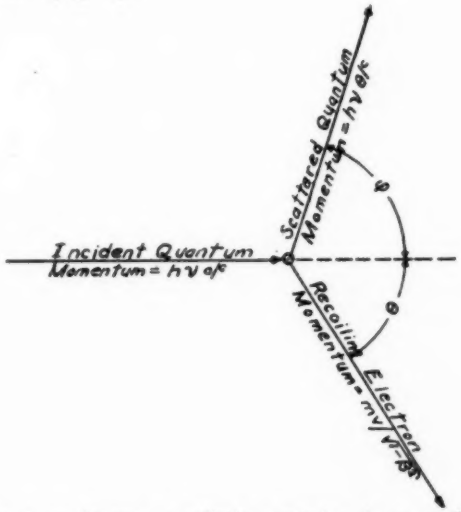

Fig. 3. — Process or radiation scattering in a medium. (Compton).(3), (4)

It has been shown experimentally that a large percentage of scattered x-rays leave a scattering medium with reduced energy. The energy that is left in a scattering medium results in the projection of electrons known as recoil electrons. The reduced energy of the scattered x-ray is evidenced by an increase of the wavelength. Therefore, as the radiation penetrates the tissue, the average wavelength is gradually increasing. This has been shown experimentally by Failla[5] and Quimby.[6] The short wavelength x-rays scatter a greater number of times before being totally absorbed than the longer wavelengths. If it is desired to enhance penetration of radiation in tissue, it is necessary to increase the exciting voltage as well as increase filtration so as to have the useful beam composed mostly of short wavelength radiation.

Leucutia and Corrigan[7] have experimentally shown a gradual increase of penetration for radiation produced by exciting voltage ranging from 200 K. V. to 550 K. V. and filtered by 7 mm. steel + 1/2 mm. cu.

+ 2 mm. al., while back scattering to the surface decreased. There is a small increase in penetration at 5 cm. depth and a proportionally larger increase at 10, 15 and 20 cm. depth. This is explained by the "Compton Effect" in that the minimum wavelength decreases as the voltage increases, resulting in shorter wavelength radiation scattering a greater number of times before being totally absorbed. As the minimum wavelength becomes shorter, there is a greater tendency for radiation to scatter in the direction of the beam and less tendency for back scattering; hence a reduction of the intensity of the skin. Since the percentage of radiation reaching 10 cm. depth is a ratio of a measure of intensity at 10 cm. depth, and the measure of intensity on the surface, the penetration is increased as the minimum wavelength decreases, due to a decreased skin intensity and an increased depth intensity. From a practical standpoint in treating patients, a greater number of roentgens can be delivered to a tumor bearing area through a smaller number of skin portals by employing supertherapy, because of increased penetration, than by what has been known in the past as deep therapy (200 K. V.). The question naturally arises as to the total quantity of superradiation that can be safely administered to a patient and whether the same number of roentgens can be delivered to the tumor bearing area with deep therapy, providing more skin portals are used in the process of cross-firing.

Supertherapy Radiation

To date, there has been no proof that types of malignancy not amenable to the quality of radiation produced by deep therapy respond more to supertherapy radiation. At present, the development of supertherapy radiation has progressed faster than the development of apparatus to measure the roentgen accurately. Until it is accurately known that the supertherapy roentgen is the same as the deep therapy roentgen, it will not be known whether analogous quantities of radiation are being employed in both cases.

The following table of data obtained by Leucutia and Corrigan[7] represents the variation in penetration with change in voltage for 5 and 10 cm. depth.

Weatherwax and Robb[8] have measured

TABLE 1. — *Variation in Penetration with change in voltage for 5 and 10 cm. depth.*

K.V.	S.T.D.	Field	Filter	5 cm. Depth	10 cm. Depth
200	60 cm.	400 sq. cm.	7 mm. Steel + ½ mm. cu. + 2 mm. al.	78%	43.0%
300	60 cm.	400 sq. cm.	7 mm. Steel + ½ mm. cu. + 2 mm. al.	79%	46.0%
400	60 cm.	400 sq. cm.	7 mm. Steel + ½ mm. cu. + 2 mm. al.	79.5%	49.5%
500	60 cm.	400 sq. cm.	7 mm. Steel + ½ mm. cu. + 2 mm. al.	80.0%	52.0%
570	60 cm.	400 sq. cm.	7 mm. Steel + ½ mm. cu. + 2 mm. al.	80.5%	53.0%

deep therapy radiation for 200 K. V. for different sized fields, keeping the filter and voltage constant and showing the variation in penetration as the skin target distance is changed from 50 to 80 cms.

It is seen (table 2) that the depth dose for 200 K. V., 1/2 mm. cu. ÷ 2 mm. al. at 80 cm. Skin Target Distance is 47 per cent; while the depth dose for 570 K. V. at 60 cm. S. T. 7 mm. steel + 1/2 mm. cu. + 2 mm. al. is 53 per cent. If 2 mm. cu. is substituted for 1/2 mm. cu. filtration in 200 K. V. radiation, the intensity at 10 cm. depth will be about 52 per cent.

Again, if malignant tissue does not have an affinity for a particular quality or part of the radiation spectrum, then the depth dose obtained by super high voltage short wavelength radiation can be approximated with deep therapy radiation by employing filters of 2 mm. cu. equivalent and Skin Target Distance of about 80 cm.[9], [10], [11]

The advent of super-high voltage therapy has stimulated radiologists using deep therapy to give more attention to methods of applying radiation. It is true that it requires ingenuity and good management to cross-fire a tumor accurately with multiple portals of entry, as well as properly to protect the skin, but it can be done if anatomical charts are reproduced to show the depth dose from each field with the portals carefully outlined, as shown by Weatherwax and Widmann.[12], [13]

The use of supertherapy is challenging the radiologists using deep therapy to take their bearings upon whether they are delivering the greatest possible total quantity of radiation and also whether they are employing the proper technics. It will require a few years in order to properly evaluate clinical findings and experimental data in the use of super short wavelength radiation before radiologists will know whether the

TABLE 2. — *Relative Depth Intensities (200 K. V.)*

Depth in Water	20 cm. dia. Field S. T. D.			16x16 cm. Field S. T. D.			14x14 cm. Field S. T. D.			10x8 cm. Field S. T. D.			6x8 cm. Field S. T. D.		
	50	70	80	50	70	80	50	70	80	50	70	80	50	70	80
Half sub.	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
2 cm.	95	97	98	92	95	98	92	94	97	91	93	94	88	92	94
5 cm.	72	76	78	69	75	78	67	70	77	64	68	70	59	63	68
7 cm.	57	62	64	52	60	64	51	58	62	49	52	53	42	48	52
10 cm.	39	45	47	35	43	46	33	41	44	30	36	38	26	33	38
15 cm.	18	24	27	17	23	26	15	22	26	13	19	21	11	18	20
20 cm.	8	13	16	7	12	16	6	11	14	4	10	13	3	10	11

trend in radiation therapy is definitely towards increased exciting voltages.

Summary

1. The quality of the beam of radiation is a function of the voltage applied to the target of the x-ray tube.

2. As higher voltages produce shorter wavelength radiation, more filtration can be used with a corresponding increase in the depth dose.

3. If the tumor tissue response to radiation is not a function of the quality, then radiologists using the present deep therapy installations are challenged to manage treatments in a manner to deliver to the tumor bearing area a quantity of radiation equal to that quantity obtained from supertherapy.

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Discussion

Dr. B. P. Widmann (Philadelphia): While this paper is very technical, it is the fundamental working basis of all radiation procedures. At present all physical and biological studies conform with the clinical impressions of radiologists, that various qualities of radiations, both x-rays and radium, have similar or identical effects on tissue.

The difference is one of penetration and absorption. The hard or short wavelength x-rays which necessitate higher voltages are naturally more penetrating and for this reason are necessary in the treatment of deep seated malignant disease. At the Philadelphia General Hospital we have repeatedly demonstrated that an epithelioma of the lip or of the skin anywhere will regress completely with radium treatment using every practical type of filter and thickness as well as with x-rays with no filter and varying thickness of aluminum filter and low voltages and high voltages. These observations are in conformity with the impression that different wavelengths or qualities of radiations will produce the same biological effect providing the same intensity of radiation is employed. These studies were carried out simply and accurately because only superficial effects of radiation were involved. For this reason we believe that for certain superficial lesions, softer qualities of radiation are more desirable, because the surrounding and deep lying normal tissues are not affected by the radiation so far as concerns the production of the usual secondary changes of fibrosis and hyalinization, which interfere with the local circulation. At present there is no evidence to indicate that the very high or so-called supervoltages of 500,000 to a 1,000,000 volts are going to produce radiation qualities of any superior value from a biological standpoint; higher voltages definitely admit greater penetration and absorption. The present line of reasoning would suggest that we first meet the possible insufficient depth dosage from our present 200 K. V. equipment by increasing the portals and adopting the technical procedures of so-called cross-firing which were so well known to the radiologist of

earlier days before the advent of higher voltages. Theoretically multiple fields and cross-firing should give any desired depth dose. It is certainly true that today there is a tendency to under-treat rather than over-treat. Future progress in radiology is undoubtedly going to involve some technical procedure that will admit of possibilities of giving more treatment within the limits of the skin and physical tolerance of the patient. It is for this reason that there has been a general tendency to bring about some clinical, as well as, experimental evidence with respect to so-called supervoltages. It would seem more wise to consider what advantage might accrue from the use of additional fields of radiation or so-called cross-fire radiation and employing as many additional fields as will show on charts to increase the depth dose with our present 200 K. V. equipment. Supervoltage technic is going to be an expensive procedure and at the present time it is not very practical, but the expense should not deter its use if subsequently it is shown to produce better results.

A METHOD FOR STUDYING THE EFFECTIVENESS OF 700 K. V. X-RAYS *

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In recent papers[1,] [2] Lauritsen has discussed the energy available from x-ray radiations of different qualities. The relationship between the r-unit intensity of the incident beam and the amount of energy which can be expected to be absorbed by the skin and by the deeper tissue should be of vital importance to those interested in deep therapy. For example, he has presented theoretical data which must be interpreted as showing that, for a given amount of energy absorbed in the skin, a beam of the hardest, "super voltage" x-rays now in use will approximately deliver twice as much total energy to the irradiated body as will a beam of the softer rays produced with the customary 200 K. V. technic.

Lauritsen has suggested that it is logical to expect that a biological effect on a given irradiated tissue will depend fundamentally upon the amount of energy absorbed by that tissue and that the effect of a special sensitivity of the tissue to any specific wavelength, if there is such a thing, will be merely superimposed upon this energy-absorbed dependence. Because of the complex nature of the problem when a heterogenous beam penetrates a mass of material such as tissue, it was not possible from these theoretical considerations to determine the amount of energy which is absorbed at any given point inside the mass; in other words, a simple depth-dose relationship. However, Lauritsen was able to predict a dependence of the surface effect upon the hardness of the beam, one which approximates what has so far been clinically observed in the case of the erythema dose.

The apparent reasonableness of the assumptions made by Lauritsen gives his conclusions great weight. It seems fitting therefore that effort should be made to check them experimentally as they apply to deep therapy. Unfortunately this is not an easy matter. The altogether too popular method of measuring so-called "depth-dose" by means of small air-ionization thimble-chambers offers little or no help. Considering the wide dependence[3] of the results obtained by thimble-chambers upon their construction and upon the exact quality of ray striking them, many of the conclusions which have already been drawn from them are not far from ridiculous. All too frequently one hears of a roentgenologist who, after measuring his equipment's output with some convenient thimble chamber carries the numerical value of his "depth-dose" about in his mind, so that he might compare it with some other equipment, or with his own of a different technic.

The best that can be said for the thimble

* Read under the title "Some Physical Aspects of 600 K. V. Radiation," at the Thirteenth Annual Session of the American Congress of Physical Therapy, Philadelphia, September 11, 1934.

chamber, in its present state of perfection, is that it offers a convenient clinical means for empirically reproducing a given quantity of radiation in identical environments and under identical qualities of radiation. In open air these conditions are easy to meet, in tissue they are harder to meet than is generally believed.

Multiple Indicators for Simultaneous Irradiation

When the effects of radiation are to be compared at points inside of tissue, an organic indicator whose own scattering and absorbing power is identical with that of the adjacent tissue, seems to be the more logical. Something is needed which might be imbedded intimately in the tissue at any depth as well as in thin surface layers. A method which permits several different indicators with the above characteristics to be irradiated at several depths simultaneously is being developed at the Lincoln General Cancer Clinic. It is the purpose

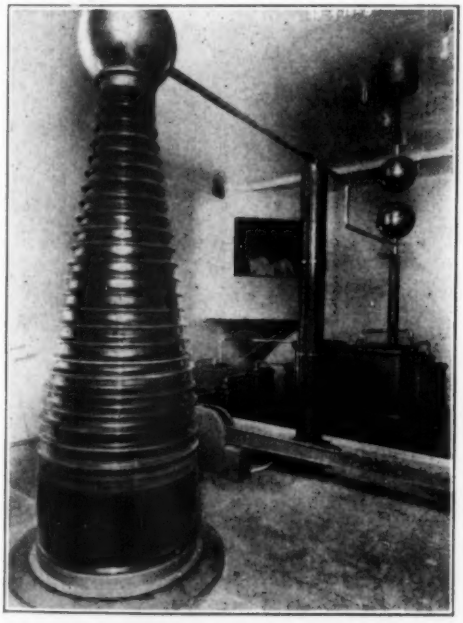

Fig. 1. — The nine foot porcelain insulating portion of the tube projecting through the roof of the treatment room. The 700 K. V. constant potential rectifiers in the background.

of this paper to make a brief preliminary report of this work.

Certain difficulties preclude the use of Drosophila eggs in this work. The susceptibility of these eggs varies so rapidly with time[5] that a great number of flies would be needed to yield enough eggs simultaneously so that several samples could be irradiated at one time. It was feared also that the eggs would be too fragile to stand intimate imbedding in the tissue substitute.

Bacteria. A number of bacteria were irradiated in search for one sensitive enough to be of practical use. It was found that the bright red, non-pathogenic *Serratia fuchsinis* was many times as sensitive as any of the others tried. Later *Seudonomas pyocyaneous* was found to be about equally sensitive. These two microörganisms, although they are not of the anerobic type, produce subsurface colonies down to a depth of at least four mm.

A method of distributing the bacteria uniformly through the agar was developed. A special agar-mixing device which rotated the mixing bottles on two axes simultaneously had to be devised. The bacteriologic technic was developed through the generous cooperation of Mr. Sayre Proudfit, of the bacteriological department of the University of Nebraska.

Several types of containers for these agar slabs were tried, but soft paraffined cardboard trays, seven cm. square by three mm. deep were adopted. Into the sterile trays were pipetted twenty cc. portions of the freshly mixed agar, which had previously been inoculated with a number of organisms, about 500 to 1,000, from a dilution of a twenty-four hour old culture. Seven test trays and three control trays were prepared at one time. The trays were then poured level with low melting paraffin to prevent contamination during irradiation.

It was decided to irradiate the bacteria during the logarithmic phase of the growth curve, and to keep both the time of irradiation and the time of preparation constant. Therefore, two hours were allowed before the trays were irradiated in the special phantom, the exposure also being two hours. Following the removal from the phantom, the test trays were stripped of their paraffin covers and incubated at 37 degrees C. for thirty hours or more. After incubation the surface colonies and any surface contamination were carefully washed off, and a count was made of the deep colonies with the aid of a lens. The subsurface colonies appear to have roughly the same

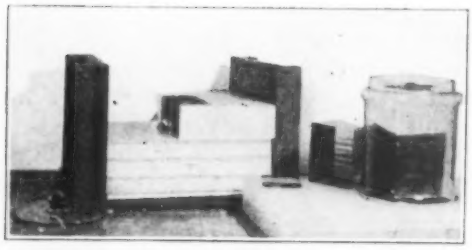

Fig. 2. — The special paraffin phantom with some of the paraffin blocks removed showing seven of the flat agar cells containing bacteria.

degree of sensitivity as the surface colonies.

The phantom used was a twenty-eight cm. cube of paraffin, made of slabs cut in such a manner that seven of the trays would fit into it at one time, one being at the surface and the rest spaced with paraffin at six depths along the axis of the beam to a maximum of fifteen cm. from the surface. In this manner the effect of irradiation upon a surface layer of any desired thickness may be compared with the effect at any depth.

No attempt was made in these preliminary tests to make any exact comparison of the effect at various depths and with various voltages. The purpose was to establish a useful range of time and intensity so that readable effects would occur at the maximum depth as well as at the surface. It was found that a two-hour exposure at thirty r. per minute was effective, in the range of voltage between 300 and 700 constant potential K. V. in killing 70-90 per cent at the surface and about fifty per cent of the colonies at the ten cm. depth. The air intensity was obtained by means of a large open-air chamber of the Lauritsen type.

Methylene Blue. It was noticed that this radiation technic was suitable for producing also a measureable fading in dilute methylene blue dye solutions. The method of Stenstrom[4] for determining a radiation effect by measuring the fading in this organic dye was tried with the hope that cells containing the dye might also be included in the phantom at various depths simultaneously with the irradiation of the bacteria.

Stenstrom's technic proved to be every bit as hard to reproduce as he had predicted. Only after his thin paralodion solution containers were replaced by larger test cells cast of paraffin which had been purified with sulphuric acid and sodium hydroxide could reproducible results be obtained. The construction of a suitable chamber thin enough to measure a true surface effect still remains a problem.

Three different photocolorimeters were built for measuring the fading of the dye. A suitable instrument for use with very dilute solutions, having an inherent inaccuracy of less than one per cent, was finally developed making use of a Weston photronic cell, a galvanometer, a Wratten No. 25 filter, and a neutrol-grey compensation wedge.

A twenty-eight per cent decomposition of the dye could be obtained with the maximum exposures given the bacteria at

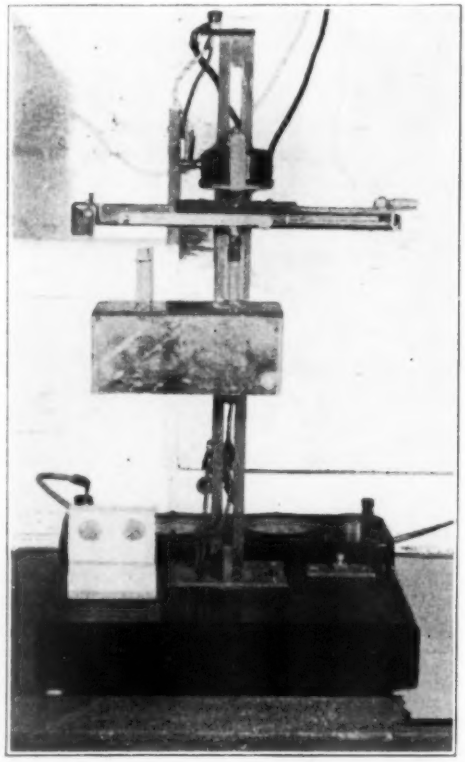

Fig. 3. — Special photo-colorimeter for measuring the fading in dilute methylene blue solution due to radiation.

depths of two cm. below the surface. This permits the dye to be used simultaneously with the bacteria and with some accuracy.

To a first approximation such a phantom with its gelatinous and aqueous indicators can be considered an homogeneous mass, scattering and absorbing the same as would a mass of tissue. It is apparent that a great number of exposures are necessary

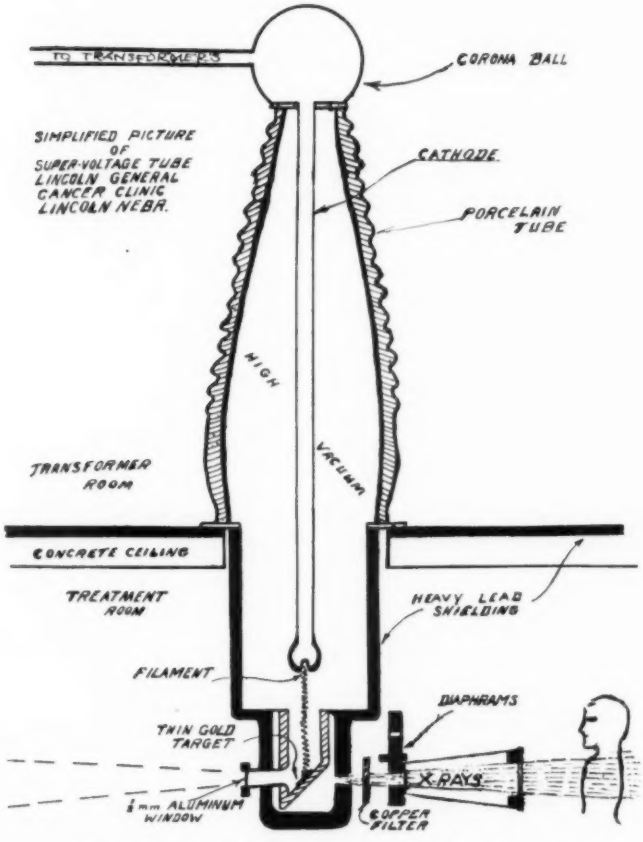

Fig. 4. — Simplified cross section of 700 K. V. constant potential tube built by Kelley-Koett Mfg. Co.

before the effects at various depths caused by various qualities of radiation can be compared. When one remembers that two hours are required for each exposure and about four more during the preparation of the test cells, one can appreciate the advantage in combining as many as three different indicators at seven different depths for simultaneous exposure.

The work done by Failla[3] and his collaborators has shown that a discrepancy can be expected between comparisons made by means of the different indicators. However, the phantom just described has been designed to reproduce as near as possible the scattering and absorbing character of tissue in the immediate neighborhood of the indicator, which in itself is of the composition and order of magnitude of the cell in tissue. In other words, an attempt has been made to approximate the requirements for measuring the energy absorbed inside the mass of tissue. A discrepancy between the results obtained by the different indicators will possibly make known the relative importance of any wavelength-selective effect.

It seems of vital importance that any such comparisons of the effect of x-rays from various voltages should come from one apparatus capable of producing the required amount of intensity throughout the full range of voltages and filters in question. The 700 K. V. constant potential equipment at the Lincoln General Cancer Clinic seems to be admirably suited for this purpose. An intensity of thirty or more roentgen at fifty cm. distance can be obtained through three mm. of steel and six mm. of copper at 700 K. V. in five horizontal beams. A continuous reading output R-meter shows less than one per cent fluctuation when the tube is run for hours at 600 K. V. It has been found necessary to install a thin aluminum window in the heavy, water-cooled anode casing, so that sufficient intensity of rays in the 100-200 K. V. range can be pro-

duced for these experimental purposes. A special anode having a one-half mm. aluminum window is now under construction.

Summary

The need is discussed for an adequate experimental comparison of the biological effects at various depths in tissue of x-rays produced at voltages between 100 and 700 K. V.

A technic is described for using two different sensitive bacilli mixed into agar slabs which are placed at several depths in a special phantom for determining the effect of hardening radiation, also a method for including a methylene blue indicator in the same phantom for simultaneous irradiation.

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LINCOLN GENERAL CANCER CLINIC *

A Preliminary Report on 600 K. V. Constant Potential Radiation

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Our experience with high voltage x-ray therapy has only been of one year's duration and a large number of our patients have been in the terminal stages of malignant disease when accepted for treatment. For these reasons I will make no pretense of fully reviewing the work done and drawing any definite conclusions as to its ultimate value. I wish, however, to present a few of the problems confronting us with this type of therapy and to describe the technic in use at our cancer clinic, and to cite briefly a few cases illustrating what seems to us to be much better results than could be expected of lower voltage radiation.

We are convinced that there is no accurate method at the present time of determining the exact amount of radiation delivered within the body at a given distance from the skin. Our dosage is not based on depth dose measurements. We are more concerned in securing the most effective beam of radiation, and we believe that this can best be done by maintaining extremely high voltage and administering the largest dosage of this type radiation that can safely be tolerated, through adequate filters at 74 centimeters focal skin distance. The higher the voltage the shorter the wavelength, and the shorter the wavelength the more effective and greater the pentration.

We administer 600 K. V. radiation through multiple ports, usually 12x24 cm., cross fire method, patterned after the technic of Seeley G. Mudd of Pasadena. Our setup consists of 6 mm. copper, 4 mm. steel, 4 mm. aluminum, 15 mm. water and 2 mm. bakelite filters. We deliver 300 R. units per day over each skin area over a period of three or four weeks, cross-firing through four or six portals of entry. From 2000 to 2000 R. may be administered at one time per skin area.

Technic of Superhigh Voltage Radiation

The application of 600 K. V. radiation is entirely different from that of 200 K. V. radiation. The most marked difference is the large amount of radiation that can be tolerated without damage to normal structures. We have noticed marked recession

* Read at the Thirteenth Annual Session of the American Congress of Physical Therapy, Philadelphia, September 11, 1934.

of tumor tissue with no radiation sickness and only moderate tanning after the second series. Small doses over a longer period seem to produce better results than large doses over a shorter period of time.

Every attempt has been made to learn the effect of 600 K. V. radiation on tumor and normal tissues. In almost all cases the clinical diagnosis has been proved either by biopsy, exploratory operation or autopsy. In practically all cases applying for treatment a full series of 600 K. V. radiation has been administered before surgical intervention was undertaken. At the conclusion of the first series any indicated surgical measures have been carried out. Numerous sections have been made of these radiated tumors in an effort to evaluate the effects of radiation and when possible these sections have been compared with biopsy material taken before x-ray therapy. Abundant material has usually been obtained at autopsy for similar microscopical study. Also a careful examination has been made of the various organs and tissues in the path of the most intensive radiation and they have shown no morphologic changes that could be attributed to the treatment.

We agree with Bloodgood, and others relative to preoperative and prebiopsy radiation. Changes that we have observed in tumor tissue following radiation with higher voltages have left no doubt in my mind as to the value of this procedure.

During the past year we have treated 175 patients with malignant tumors at our clinic. Only those who seemed to be terminal were refused treatment. Patients with extensive lesions were accepted for palliation, if in our judgment they would live a sufficient length of time to show some effect of their treatment. We have demonstrated to our satisfaction that in these advanced cases 600 K. V. radiation is by far the most effective palliative treatment. Frequently we have so greatly relieved them of their pain and discomfort, in as few as five days, that they have voluntarily discontinued the use of morphin. I have known cases requiring five injections of a quarter grain of morphin in 24 hours to cut the amount by their volition to ⅛ grain night and morning.

In patients having superficial metastases, such as are frequently found in and under the skin on the chest wall following a mammectomy for carcinoma, we have observed that 600 K. V. radiation has failed to reduce or cause them to disappear. In such cases a full dose of 600 K. V. radiation is administered in the usual manner, selecting two 12x24 centimeter areas on the anterior chest wall, a 24x24 centimeter one over the posterior surface of the thorax and a smaller one 6 centimeters in diameter through the axilla directed upward to include the triangle of the neck.

Immediately following the high voltage radiation a threshold erythema dose is delivered to all the skin covering the anterior and posterior as well as the lateral surfaces of the thorax with 140 K. V., 3 millimeters aluminum and 35 centimeters focal skin distance. This combination of low voltage treatment following a full dose of high voltage causes the small metastatic areas to disappear rapidly.

During the second and third series we have noticed marked leucopenia. We found the intramuscular administration of Lederle's liver extract at intervals of 7 to 10 days the most effective treatment for this condition. The red cell count, the differential and the hemoglobin are little affected. The sedimentation rate of the erythrocytes was done routinely at stated intervals for several months, but was abandoned as it seemed to give us no useful information.

History of Cases

Some of the results we have obtained can best be illustrated by the following case reports, which contain copies of the pathological reports of Dr. J. Marshall Nealey.

Case 1. — Mr. B., age 54. Consulted me November 6, 1933, complaining of harassing cough from which he could get no relief. Six months prior to this date he had a diagnosis of primary carcinoma of the lung. An x-ray plate at the first observation showed a circular area of increased density about 2 inches in diameter near the root of his right lung. He was given a series of 200 K. V. radiation. When I examined him six months later an x-ray plate showed a large diffuse area of increased density about six inches long involving the entire root and adjacent lung on the right side.

A series of 600 K. V. radiations was given over a month's duration totaling 4,800 R. units, after which he was greatly improved and resumed his occupation. Two months later he returned for his second series, feeling well. Roentgenograms at this time showed a complete disappearance of the tumor. There was considerable retrac-

tion of the lung and the heart was pulled over into the right pleural cavity. These roentgen findings were later verified at autopsy. During the second series of treatments he developed a divergent squint, ptosis of the lids, choked discs, nausea, later became irrational and died March 9, 1934.

Pathological Report. *Lungs*: Many sections taken from various parts in the right lung show as the most prominent feature a remarkable proliferation of histiocytes most of which are laden with brownish black pigment. In some areas there is localized pneumonia, where polymorphonuclear leucocytes predominate. Sections of bronchial mucous membrane show nothing of note save for some proliferation of the epithelium. There is a general increase of fibrous connective tissue throughout the right lung. There are no definite recognizable groups of carcinoma cells, although in some areas there are cells which, while completely isolated, may represent carcinoma. *Brain*: Sections of the brain show metastatic carcinoma. *Diagnosis*: Primary carcinoma of the lung, metastasis to the brain, cerebral malacia. Evidence that the primary tumor growth was in the lung is based chiefly on the fact that repeated x-ray examinations showed a mass in the right hilus which, though it promptly and apparently had disappeared under 600 K. V. therapy, gave rise to cerebral metastases. Furthermore on careful search no primary tumor was found elsewhere at autopsy.

Case 2. — Mrs. Bean, age 75 years. She first consulted me February 6, 1934. She had a large nodule in the upper outer quadrant of her left breast. It measured about 3½ inches in diameter. It was hard, slightly movable and attached to the skin. She had known that a small nodule was present in the breast for several years, but it had only lately increased in size. A series of 600 K. V. radiation was administered in the same month. A second series was administered after a two month's rest, making a total of 8,400 R. units. She returned for observation six weeks after her second series and examination revealed a small hard nodule in the upper outer quadrant of the left breast which measured about one inch in the greatest diameter and three-fourths of an inch in the smallest diameter. It was freely movable and approximately one-fifth the size of the original tumor. There was no involvement of the axillary or supraclavicular glands and an x-ray plate of the lung and mediastinum was likewise negative. The breast was removed July 13, 1934 by simple mammectomy. No attempt was made to remove the pectoral muscles or disturb the axillary glands. She will receive the third series two months following her operation. Numerous sections were made of the nodule.

Pathological Report. *Microscopical Findings*: The sections consist largely of dense fibrous tissue with varying sized islands of carcinoma cells. These cells occur in sheets and strands, and show general pycnosis of the nuclei and their cytoplasm is granular and often vacuolated.

No mitotic figures are seen. In some instances the masses of carcinoma cells appear shrunken and some are undergoing necrosis. Rarely the necrotic material is infiltrated with inflammatory cells, and here only occasional malignant cells remain. In other areas fibroblasts are invading the necrotic areas.

Diagnosis: Scirrhous carcinoma of the breast undergoing degeneration.

Case 3. — Mrs. S., aged 56. This patient came to me because of a large tumor in the upper, outer quadrant of her right breast. There was considerable retraction of the breast and dimpling of the skin; 3,600 R. units of 600 K. V. radiation were delivered through three portals of entry during November, 1933. She returned on December 15, 1933, for a mammectomy. The tumor had receded to one-third of its original size. The retraction of the skin was barely visible. A mammectomy was accomplished by electrosurgery. Her recovery was uneventful and she returned home on the 24th of December. The following pathologist's report is of great interest.

Microscopic: Sections of the breast tumor which had received high voltage therapy before removal show many striking changes in the tumor cells. Most of the sections show only shadows of tumor cells remaining. These cells show small pycnotic nuclei and their cytoplasm is distended with a clear, pale-staining substance. Other areas show the cytoplasm to be granular and there is a marked degree of karyorrhexis. At the periphery of the tumor mass there are a few cells which, as judged by their staining characteristics, appear to be still viable. However, even in these areas there is definite indication of cell damage.

Case 4. — Mrs. P., aged 50. She first consulted me in 1931 immediately following a resection of a tumor in the left axilla. We gave her a series of 200 K. V. treatment according to the usual procedure in this type of radiation. She remained well for about one year at which time she again consulted me for a nodule near the margin of her previous scar. Biopsy proved this to be Hodgkin's disease. The area of recurrence was thoroughly treated with radium needles which were imbedded in and around the pathological area. The lesion promptly disappeared. On October 24, 1933, reëxamination showed marked loss of weight, a harassing cough and constant pain in the upper right chest. An x-ray plate on this date shows a consolidation of the upper lobe of the right lung, and a small circular area of increased density in the left root. One treatment of 600 K. V. radiation was administered daily for 18 days. She received a total of 3,600 R. units. After the first ten days her cough and pain subsided and when she was dismissed she was symptom free. She returned for a radiographic examination one month from the time her treatment was begun. She was symptom free and her x-ray plate of that date showed complete disappearance of the consolidation in the upper right lobe and in the left root area. Two additional series were administered at two-month intervals, a total of 13,800 R. At the present

time she is symptom free and x-ray plates of the lung are negative.

Biopsy Report. *Gross*: Spherical encapsulated tumor 2.5 cm. in diameter having the gross characteristics of lymphatic tissue.

Microscopic: There is a diffuse hyperplasia of small and large mononuclear cells, the normal architecture of the gland being destroyed. In certain areas a small amount of fibroblastic proliferation is seen. There is an unusually large number of giant cells, mono- and multinuclear, of the typical Sternberg-Reed type.

Diagnosis: Hodgkin's disease.

Case 5. — Mrs. E., age 51. She first noticed a lump in the left breast in 1925. The breast was amputated and she remained well for six years. At that time the operative scar broke down and she received 140 K. V. radiation. The slough persisted and surrounding this area of degenerated tissue was a ridge which was hard and indurated, and a number of small, hard nodules scattered over the chest wall just under and in the skin. Late in 1932, she noticed a nodule in the right breast which was operated early in 1933. When she presented herself to me for treatment October 6, 1933, we found in addition to the lesion described, a left hydrothorax. A series of high voltage treatments was given in October through six portals covering the entire thorax; she received a total of 6,000 R. units. Two months later the second series was given, a total of 7,200 R. units. April 21, 1934, her third series of radiation was started and completed May 26, 1934. During this period there was but little recession of the tumor tissue and it also had been necessary to perform paracentesis of the pleural cavity six or seven times during the course of her treatment. In May, 1934, four large areas covering the chest wall received an erythema dose of low voltage radiation with 140 K. ., 3 millimeters aluminum and 14 cm. focal skin distance. This produced a threshold erythema which subsided in about two weeks. When she reported for observation July 11, 1934, all the induration and nodules had disappeared. The sloughing area over the anterior left thoracic wall had decreased in size. Only a small area one inch in diameter remained. The low voltage radiation was repeated and an x-ray plate at this time shows normal costo- and cardio-phrenic angles on both sides. There is moderate increase in density near the base of the left lung which, I believe, is due to thickened pleura. There is no evidence of fluid in the pleural cavity and clinically she is enjoying the best of health.

Case 6. — Mr. L., age 84. He had a large palpable mass surrounding his anal canal and extending up the bowel for 2 or 3 inches. The rectum was constricted so that it was impossible to insert the examining finger. There was marked loss of weight, cachexia, no appetite, a constant feeling of uneasiness, extreme pain, and insomnia. He was thoroughly aware of his condition and had given up all hope of relief. A total of 6,000 R. units of 600 K. V. radiation was administered through five portals of entry during October, 1933. Beginning January 4, 1934, a second series was given, a total of 7,000 R. units. He had gained in weight and he had the appearance of a normal man of 70. He was unusually vigorous and had no pain. His diet consisted of ordinary food. He was allowed to return to his home and again presented himself three months later for the third series. The same five areas were selected and 8,000 R. units weer administered.

Throughout this entire period he has remained symptom free. Before he was dismissed a proctoscopic examination was made without difficuty. A small red slightly pedunculated area in the rectal wall was visible, in all probability the site of his original tumor. To date he is in perfect health. No attempt was made to remove a section for biopsy at the conclusion of treatment. The clinical diagnosis was adeno carcinoma.

Case 7. — Mr. A., age 40. Originally this patient had a sarcoma involving the right inguinal glands. Repeated attempts had been made to eradicate the tumor surgically. When the patient arrived in Lincoln there was a huge mass involving the right groin extending well up into the pelvis. His right leg was edematous and twice the size of the left. He had lost weight and was suffering excruciating pain. It was almost impossible for him to maintain the necessary position on the treatment table. After the first two weeks of treatment he had improved to such an extent that he secured a room and made daily trips to the institution for treatment. His first series of treatment terminated in one month's time, after which he walked three blocks to the car line, took a street car to the bus depot and proceeded to his home in an adjoining state. He receieved three series of 600 K. V. radiation at intervals of two months, totalling 28,000 R. units. When he presented himself for the third series, his improvement was marked. He was practically free from pain, he had gained weight, the tumor had receded to a mass about two inches in diameter. The right thigh had diminished in size until it closely approached that of the left, with full function of his right hip joint. He walked with only a slight limp. He has returned to work as overseer of a gravel pit.

When he first presented himself for treatment we did not make an x-ray examination of his pelvis due to the fact that we felt he would not live long. At the time of his second series a roentgenogram showed positive evidence of a destructive lesion involving the pubis, the ischium, and the acetabulum. An x-ray plate at the close of his third series shows some regeneration of bone.

Summary

1. Our method of treatment is described.

2. The problem of measurement of depth dosage is discussed.

3. The effects of high voltage radiation on tumor and normal tissues are briefly discussed.

4. Preoperative radiation is recommended.

5. Treatment of apparently hopeless cases seem to be justified because of its palliative effect.

6. Skin and subcutaneous metastases so resistent to either low or high voltage therapy alone have responded well in our hands to a combination of the two, the 600 K. V. being given first followed by 140 K. V., a threshold erythema dose.

7. Several illustrative cases are reported.

Conclusion

Further intensive study of methods of measuring depth dosage in high voltage therapy, of its effects on tissues both normal and tumor, of its effect on physiological chemistry, and many other lines of investigation must be carried out. Some of these studies are being made in our clinic. Insufficient data prevent as yet any definite statements of our present observations.

A year is insufficient time to permit a critical review of the cases treated, yet certain observed facts prompted me to draw attention to some points which seem important. I feel we can make the following recommendations on the basis of our work up to this time.

We recommend one series of 600 K. V. radiation preceding early radical resection of operable malignant tumors, or biopsies, to be followed by two post-operative series.

For the relief of pain and to prolong life in inoperable cancer we advocate 600 K. V. radiation possibly combined at times with radium. We believe high voltage radiation surpasses any other type of palliative treatment.

A proper combination of 600 K. V. radiation with other methods such as radium, electrocoagulation, and surgery offers the most feasible method of treatment of malignant neoplasms, which, when properly applied, will result in a lowered death rate and in palliation of incurable cases.

Discussion

Dr. A. F. Tyler (Omaha, Nebraska): Dr. Smith has done well in calling this a preliminary report. It is only by reporting progress from time to time that sufficient data will be accumulated so that we can draw some real conclusions as to the value of any new form of treatment.

It is a wise plan that he follows out, of having a group of men working together, internists, surgeons, radiologists, physicists and pathologists. This gives an opportunity for thorough study. The results which he has offered us this afternoon are certainly interesting. I hope that at a future date we may have another report from him so that we will have further information.

Dr. George Pfahler (Philadelphia): The subject discussed by the two speakers is an important one. These tremendous outfits require, generally, a special building because of their very high voltage. They are extremely dangerous from the electrical standpoint, and therefore, they require an unusual amount of insulation, and because of the very high filtration and the very deep penetration of the rays, they require an unusual amount of protection for the operator and the assistants against secondary irradiation. That calls for a tremendous expense.

We are deeply indebted to the various institutions that have installed these outfits under great difficulties and at great expense. We must consider the subject also very carefully because in these days, excepting in Washington, we cannot call for these large sums of money to install these outfits, and we have great difficulty in meeting the expenses that are necessary to carry on the treatment with even the smaller voltages.

Theoretically, we should obtain better results, because the higher the voltage, the greater the amount of filtration. But up to the present time I am not convinced that these superior results have been obtained. I have seen duplicate results with 200,000 volts and even, in some instances, with 140,000 volts. However, it does not mean that because I have seen it with lower voltages that the lower voltages are just as good. I do not want to give that impression. I think that at the present time none of us know.

One of my objecions to the present arrangements for the use of the supervoltage treatment is that it is most difficult to direct the beam of rays toward the disease very accurately. You cannot move the apparatus, but you must twist the patient into position in order to get the rays to pass through the patient in the proper line.

The engineers in this field are working on this type of equipment and in the relatively near future we will have equipment that can be utilized to a greater extent. It seems that we are sacrificing facility in the direction of irradiation at the present time to an extent that will practically overbalance the advantages that we get from the increased penetration.

We are too often called upon to treat cancer in the terminal stage. I am sure we can do more in the control of, and in the prevention of deaths from cancer by increasing our efforts to get patients under skillful treatment at an early stage. Our records show if patients come to us in the early stages, 98 to 99 per cent of them can be cured, whereas, if the patient waits until there is a more extensive spread of the disease, the percentage of cure is greatly reduced.

Cancer of the uterus, as demonstrated in the Radium Institute in Paris, showed 100 per cent of cures in the early stages. We can do a tremendous service to the public if we will educate them to be examined and treated at the beginning of their trouble instead of at the end.

Dr. Smith stated that he got rid of a tumor in the chest and afterwards the patient died of

cancer of the brain. That was because the cancer had already spread into the brain before Dr. Smith started to treat the chest, and it wasn't because the disease had spread by his treatment.

Mr. T. R. Folsom (Lincoln, Nebraska): In regard to Dr. Pfahler's mention of the adverse theoretical predictions made by certain German physicists, these have been made on different assumptions. Some of the theoretical physicists have worked with formulas and have had no facilities in checking them. There is one case which is very outstanding, that is the one of Dr. M. A. Tuve, of Washington, D. C., who, after making a very careful investigation of what might be expected along theoretical lines, and being a man working right in that field, published his expectations as being not very much in favor of high voltage x-ray for therapy.

A better mechanism was worked out by Dr. Lauritsen, of the California Institute of Technology, where the energy considerations were brought forth. Dr. Tuve admitted he had no basis whatever to draw any biological conclusions. He spent part of his time in his paper, in explaining that this should not be taken as a biological effect.

Dr. Roscoe L. Smith (Lincoln, Nebraska): Relative to Dr. Pfahler's remarks as to parallel cases that he has seen, I have seen some myself with 200 kilovolts irradiation since 1921. In the short period that I have been using higher voltages I have had better and more uniform results and a much higher average of satisfactory recessions.

The most important thing we have observed with high voltage therapy is the rapid relief of pain and the wonderful palliation on extensive tumors. Never in my experience have I noticed such remarkable relief. That applies to practically every patient we have seen.

As Dr. Pfahler has said, the most tragic thing in the whole cancer problem is the fact that we all get these patients at almost the terminal stage. Many times patients suffering from cancer have no indication whatever that there is anything wrong until they present themselves to the doctor for indigestion, and the roentgenogram reveals an extensive carcinoma of the stomach or advanced cancer in other locations.

I think the surgical viewpoint must be changed. The surgeons are prone to operate on every case of cancer that they can. They feel there is something there that has to be cut out. A very reasonable explanation for their viewpoint is that until irradiation of various types entered the field of therapy there was nothing else to be done but surgery. The surgeons have not learned that the radiologists can do more with cancer many times than they can. They still insist on removing breasts which was frankly inoperable. That must be corrected.

IONIZATION IN HAY FEVER: INDICATIONS, TECHNIC, SCOPE *

BEN L. BRYANT, M.D., F.A.C.S.

CINCINNATI, OHIO

Ionization in hay fever is, of course, not an entirely new procedure, because more than twelve years ago Demetriades, of Vienna, introduced a method which he called "Iontophoresis" which consisted of the ionization of the nasal mucosa through the medium of a combination of zinc and cadmium salts. Franklin's work, in London, on zinc ionization of the nasal mucous membranes has also been known for a number of years. The contribution, however, of Warwick, has been most important, because he has made various refinements and modifications in the technic of this method of treatment. He has given us as a result of his investigations, a treatment unit and a technic which makes it now possible to answer fairly accurately the questions which are commonly asked by hay fever victims when they first consult the physician. I use the term "victim" advisedly because all who have had the opportunity to observe many of them know that the condition of hay fever, especially if it is associated with asthma, is truly, a piti ful one.

The patient's questions are ordinarily the following: "Have you anything new for hay fever?" "Is it sure to relieve me?" "Will it control the asthma?" "Is it permanent?" "Is it long drawn out?" "Is it pain-

* Read at the Fourteenth Annual Session of the American Congress of Physical Therapy, Kansas City, Missouri, September 11, 1935.

ful?" "Is it necessary to have the treatment in advance of the hay fever season?"

By the first question, it is apparent that the patient has, as is usually the case, tried many other procedures which have been recommended for the relief of hay fever. These comprise the following: Cauterization of the four points of Killian, injection of various drugs and chemicals into the turbinates, irradiation of the nasal mucous membranes, the use of astringent sprays and nose drops, surgical procedures, such as submucous resection of the septum and complete or partial turbinectomies, and changes in diet.

With the recognition of pollens as a causative factor the discovery of methods for skin testing and desensitization, there was afforded a new and more hopeful outlook for the relief of hay fever patients. This method of treatment has undoubtedly been more universally accepted and used than any other. The first enthusiasm has gradually given way to a more conservative attitude, because only about sixty-five per cent of the patients have obtained relief for one season only. In addition a repetition of the injections often was not followed by the same beneficial result, hence desensitization of the hay fever patients has produced inconsistent results. It is therefore not surprising that a number of hay fever sufferers have developed an antipathy to this therapy.

We can, however, on the basis of results which I have observed, tell the patient that the Warwick ionization treatment produces at least ninety per cent cures. Of course, it is important to bear in mind that the term "cure" is to be interpreted as a cessation of all hay fever symptoms for one season. It is important also to point out to the patient that obviously no guarantee of permanency of this treatment can be given until enough time has elapsed to determine whether the results are permanent. It is true, of course, that Warwick has reported from a large series of cases that only a small percentage of them required a second or third treatment. Careful study of my material shows only one patient of a series treated in 1934, whom it was necessary to treat again this year. In this connection many of the patients stated that if their symptoms should return they would be willing to have the treatment repeated because ionization gave them more relief than they ever had from any other method of treatment.

It cannot be said that the treatment is entirely without discomfort, because in approximately half of the patients there is considerable after treatment pain which ordinarily lasts half a day, while in some patients there is apt to be considerable nervous reaction. The marked stuffiness of the nose caused by the thick, jelly-like membrane which forms after ionization is not ordinarily a source of great annoyance, because it is not different from the stuffiness which the patients have had during the hay fever season. Moreover, it is unaccompanied by any other symptoms of hay fever which cease in practically every case on the day of the treatment. As a matter of fact, the postoperative reactions have been definitely reduced in my experience during the past season by a few simple changes in the preparation of the patient, which I shall describe later.

The question whether it is necessary to have the treatment in advance of the hay fever season is answered by the fact that the results are far better if the ionization is carried out after the active hay fever symptoms have commenced, rather than as a prophylactic.

With regard to the indications in patients suffering from perennial asthma, even though it be aggravated during the hay fever season, such patients should be selected and treated with great caution. Various workers have shown that certain of these asthmatic patients have been made worse by ionization, apparently because the widening of the nasal passages affords easier access for the irritating substances to the tracheobronchial tree.

Technic

In describing the technic, I cannot do better than to quote Warwick[1]:

> After the patient is admitted, a history of the case in detail is obtained and then an examination of the nose is made. If the nasal septum is found to be greatly deviated, I do not attempt an ionization treatment, for it would be impossible to so pack the nose as to completely cover the entire mucous membrane. In such a case a submucous resection is indicated and the patient is advised that an ionization treatment may be given in about six weeks following the operation. Even with a straight septum, it is some-

times difficult to pack the nose so that the post-nasal space and the turbinates are entirely covered.

As a preliminary to the ionization treatment, each side of the nasal space is packed with ten per cent cocaine in 1.5 per cent ephedrine solution for ten minutes. This shrinks and anaesthetizes the nasal membrane and greatly minimizes the discomfort which might otherwise be experienced. Cotton strips one-half inch wide and about three feet long, and as thin as can be handled, are saturated with the ionizing solution and packed into the nose as far back as the post-nasal space. The electrode, already wrapped with a spiral of cotton and also saturated with the solution, is then introduced into the nose and thoroughly packed in with more saturated cotton. The electrode is connected with the positive pole, and the negative pole is placed on the right arm and kept wet with saline solution. A special resistance meter is connected with the patient to measure his electrical resistance. If, after the nose has been packed, the resistance between the arm and the nose is as high as 8,000 to 10,000 ohms, it is positive evidence that the nose is not properly packed, and the packing must be withdrawn and replaced until a suitable reduction of resistance occurs. I have found 2,500 to 3,000 ohms to be quite satisfactory. This measurement and adjustment of resistance is an important procedure and I feel sure that a number of my early failures have been due to insufficient or improper packing of the nose in preparation for the ionization.

After the nose is properly packed and the patient's resistance tested, the current is turned on gradually and the patient is watched carefully until the proper milliamperage is obtained, as noted on the milliammeter. Immediately after the current attains its maximum, a metallic taste is noted, there is an increase in the amount of saliva and lacrimation, and a slight flush appears on the face. The strength of the current should never reach the point of coagulation; I have found that 100 milliampere minutes is a sufficient treatment for one side of the nose.

The type of current is of the utmost importance in ionization therapy, as has been shown by Stevenson in his exhaustive analysis of the physics and chemistry of the ionization methods of treatment. It should be a direct current obtained from a small motor generator, capable of delivering at least 30 milliamperes when connected in series with the patient. In my own machines I have installed a filter on each side of the current to smooth out any ripples that may arise between the brush and the commutator. When one realizes how extremely dangerous it is to use any improvised apparatus, such as a rectifier or rotary converter, where there is a possibility of an alternating current getting into the patient's circuit, then it is understood why it is necessary that only a ground-free motor generator, with a limit stop be used. Furthermore, it is highly desirable that this machine be so constructed with interlocking switches and resistance meter that the patient's resistance be measured and correct readings be obtained without shock or any electrical sensation whatsoever to the patient. Several physicians who have observed this work and who had previously constructed electric wall plates or other machines which would put out a suitable amount of direct current, have tried this treatment, using these machines as a substitute for the one I have described above. Invariably, the report has been that the patient complained bitterly of the discomfort connected with the treatment and the consciousness all through the ionization of the discharge of electricity into the nose and arm. The results from such machines have been very unsatisfactory, so that I feel that a proper machine, proper electrodes and proper electrolyte is the absolute *sine qua non* for success in this method of treatment. Chemical analysis of the electrode, both before and after the treatment, has revealed the fact that the ten-minute ionic displacement which takes place from the electrode into the tissues during treatment changes the chemical makeup of the electrode so that after usage it should be discarded instead of being used the second time.

After the current has passed for a sufficient length of time, it is gradually turned off and the electrode and packs are carefully removed. The tissues are now seen to be contracted and the turbinates and septum are covered with a gray or white coating. Though, before the treatment, the patient may complain of watery, itching eyes, itching ears and palate and sneezing, these symptoms disappear almost immediately after the ionization treatment.

My only additional remarks concerning the technic is to emphasize the need for complete and very careful packing of every recess in the nose, because obviously any portion of the nasal mucosa which is not firmly in contact with the electrolyte-soaked cotton will not be ionized properly and will retain subsequently its sensitivity to the irritating substance. This point, together with the fact that the packing in the upper portion of the nose must be brought into rather firm association with the cribriform area, is sufficient to justify the feeling that this procedure should remain in the hands of otolaryngologists because, potentially, it has all of the characteristics of complicated intranasal procedures.

I have found the following procedures helpful. The patient is given a three grain pulvule of sodium amytal upon retiring the night before the treatment, and a second one the following morning about an hour before ionization. The patient then rests the hour preceding the treatment. It is advisable that the last meal, if at all taken, be light in order to avoid increased discom-

TABLE 1. — *Summary of Results Obtained in Cases Treated by Warwick Method*

Pt.	Sex	Age	Duration of Disease	Form of Disease	Previous Treatment	Reaction From Ionization	No. of Ionic Treatments	RESULTS Eyes	Nose	Asthma
W.B.C.	F	33	15 yrs.	Hay fever & asthma	Local and vaccine	Moderate	One	90%	90%	100%
L.J.L.	M	30	25 yrs.	Hay fever	Vaccine	Moderate	One	100%	100%	.....
J.E.H.	M	55	4 yrs.	Hay fever & asthma	Local	Mild	One	90%	90%	100%
A.F.	F	25	10 yrs.	Hay fever & asthma	Vaccine	Moderate	One	100%	100%	90%
L.D.T.	M	36	21 yrs.	Hay fever & asthma	None	Moderate	One	100%	100%	100%
W.S.	F	57	4 yrs.	Hay fever	None	Moderate	One	100%	100%	.....
J.H.	M	66	30 yrs.	Hay fever	Vaccine	Mild	One	100%	100%	.....
M.S.	F	44	8 yrs.	Hay fever	Local and vaccine	Severe	One	(Patient reported no improvement.)		
B.I.N.	M	48	15 yrs.	Hay fever & asthma	Local and vaccine	Mild	One	100%	100%	80%
R.F.	M	17	12 yrs.	Hay fever	Vaccine	Mild	One	100%	100%	.....
J.B.	F	15	4 yrs.	Hay fever & asthma	None	Moderate	One	100%	100%	80%
M.S.H.	F	28	16 yrs.	Hay fever & asthma	Vaccine and ionization	Moderate	One	100%	100%	100%

fort which might result from gagging due to the postnasal drainage.

Immediately after treatment the nose is inspected for the grayish film which should now uniformly cover the nasal mucosa. The reading of the resistance meter mentioned above is noted, because it reveals whether or not the packing has been properly accomplished, as an essential condition for successful results.

The patient is then allowed to rest for about two hours, after the administration of capsules containing codein, phenacetin and aspirin. These capsules are repeated during the rest of the day, if necessary. A mild eye wash and bland nose drops are prescribed and the patient is cautioned against forcibly blowing the nose because the resulting thick, jelly-like membrane in the nose should not be disturbed until its separation. When this separation has occurred, the membrane ordinarily discharges postnasally, showing that the function of the cilia has again become active. Alden examined specimens of the nasal mucous membrane before and some weeks following the ionization treatment and found that the membrane returns to normal as far as can be ascertained by histological examination. Macroscopically the nasal mucosa within a week following the ionization has a completely normal appearance.

The following presents a summary of patients treated this year by ionization. (Table 1.)

TABLE 2. — *Summary of Results as Determined by Questionnaire to Patients Who Had Received the Warwick Treatment*

Pt.	Sex	Age	Date of Treatment	Return of Symptoms This Year?	Severe?	Moderate?	Mild?	Asthma This Year?
M.K.B.	F.	16	8/22/34	Yes.	Yes.			No.
M.S.H.	F.	28	8/28/34	Yes.	Yes.			No.
G.M.	F.	20	9/ 1/34	Yes.	No.	Yes		No.
D.D.	F.	16	8/17/34	No.				No.
J.P.	M.	30	8/ 8/34	Yes.	No.	No.	Yes.	No.
A.D.	F.	29	8/18/34	No.				No.
I.R.S.	F.	25	9/ 1/34	Yes.	No.	No.	Yes.	No.
C.P.A.	F.	43	8/29/34	(Unable to contact this patient.)				
L.S.	F.	32	9/ 6/34	No.				No.
M.P.W.	F.	16	6/27/34	No.				No.

Of the first ten patients treated last year and previously reported, there follows a summary based on examination of some of them this year, and a questionnaire sent to those whom it was impossible to see. (Table 2.) None of the patients who have come under my personal observation and have

been treated by the ionization method has complained of subsequent anosmia.

Hospitalization has been recommended by a number of men who are doing this work but I have so far found it unnecessary for adult patients. Children of an age when local anaesthesia of the nose would be difficult or impossible, should be hospitalized for twenty-four hours, with chloroform anaesthesia being the method of choice.

Conclusions

An attempt is made to indicate the class of cases in which the Warwick ionization treatment can be expected to be of help. The technic is described. Certain suggestions are made as to the management of these patients, and reports are given on the patients treated during two successive hay fever seasons.

On the basis of results obtained during the past year and observation of treatments during the preceding year, there is sufficient evidence that the Warwick method of ionization for hay fever is a definite advance, affording better results than were obtained by any former method.

19 Garfield Place.

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Internal Structure of Chromosomes Explored — Scientists Find Net-Like Web or Honeycombed Structure Within the Band-Like Disks

Chromosomes, the heredity-bearing bits of living matter within cells, have had their internal structure explored to a new high point of detailed intimacy by Dr. C. W. Metz and Miss E. H. Gay, members of the research staff of the Carnegie Institution of Washington working in the laboratories of the Johns Hopkins University. They tell (Science, Dec. 21) of finding a net-like or honeycombed structure within or between the band-like disks, of which other scientists have recently shown the chromosomes to consist. (*SNL*, Sept. 29, Oct. 13, Nov. 10).

Dr. Metz and Miss Gay were impelled to undertake their research by observations made by other workers who have within the past few months made astonishing progress in the understanding of chromosomal makeup. Two earlier investigators who had seen these disks claimed that they frequently, if not always, occurred in pairs, with a clear space separating them. Within the past year, two other researchers had suggested that the genes did not lie within the dark disks themselves, but in the interdisk clear spaces. But the two ideas were not correlated; it was not suggested that the genes lay in the clear spaces between paired disks.

With the idea of exploring the problem presented by the existence of the disks in pairs, Dr. Metz and Miss Gay examined chromosomes by a technic slightly different from that in current use among their colleagues in chromosome investigation. They found that what had seemed to be paired, thin, dark disks were really the opposite sides of thicker, "biscuit-like" or "wafer-like" bodies, hollow within and divided up into compartments with a network of honeycomb-like complex of protoplasmic strands or walls.

The cavities or "alveoli" thus formed appear in some of the new-found thick disks to have a more or less regular hexagonal pattern, and the strands which other workers have seen stretched between disks "like strings with beads on them" appear to be really the walls of these honeycomb cavities.

There are regional differences in the makeup of the chromosome substance, Dr. Metz and Miss Gay report. Each region appears to have a definite type of protoplasmic structure, which usually extends across the chromosome at that level. The type may change abruptly in passing from one region to another. In some places the protoplasm appears to have a smooth, undifferentiated structure, in others it is full of large or small cavities.

The two Carnegie Institution workers suggest that there may be qualitative chemical differences associated with the differences in structure.

Some months ago, one of the other investigators likened the disk-like structures to "temples of destiny" on the "streets" of heredity which are the chromosomes. If the analogy is to be pursued further, the inter-disk cavities found by Dr. Metz and Miss Gay might be called the rooms within the temples.

But as yet nobody has actually seen the powerful controlling goddesses who dwell in these rooms, the modern Fates, otherwise the Genes. — *Science News Letter*, December 29, 1934.

SCIENCE, NEWS, COMMENTS

Dr. Victor Levine Again in Arctic

On a grant from the Federal Government, Dr. Victor E. Levine again spent the summer months in the Arctic region, for the purpose of making medical and biological studies of the Eskimo. Dr. Levine visited Teller, Diomede Islands, East Cape, Siberia, Shishmarif, Keewalik, Deering, Candle, Kotzebne, Cape Prince of Wales, Point Lay, Icy Cape, Point Hope, Wainwright, and Point Barrow. Incidentally, Dr. Levine cordially invited the Editor to dine on muktuk (whale), ayoik (walrus), and netchek (seal oil).

Need for Monochromatic X-Rays

Dr. Robert F. James, a Westinghouse research physician, believes that with an x-ray of one color, iodine or some other equally powerful antiseptic could be introduced into the body without a surgical operation, and physicians would find it easier to cope with infections of the peritoneum, lungs, sinuses, kidneys and other tissues and organs. Dr. James' theory, the correctness of which experiments on rabbits have proved, first injects a non-poisonous compound of iodine into the infected region. Then the x-rays are turned on and at once the compound is broken down and free iodine is released to perform its germicidal function. When the x-rays are turned off, the free iodine returns to the compound and is flushed away in the blood stream. Dr. James warns that only after years of research will it be possible to learn the exact conditions that must be allowed for, if we are to endure toxic iodine in our systems. An essential will be monochromatic x-rays, so that the diagnostician will be equipped to select the suitable one for the study of a particular tissue. — (*Med. Rec.*)

Surgeon Uses Cow's Horn in Treating Broken Bones

Cow's horns, prepared in the same way as the old fashioned powder horns which were used with muzzle loading firearms, are now being used to repair broken bones.

Advantages of this new device are that it is inexpensive and does not require elaborate machinery to apply it as do metal plates, Dr. Edson B. Fowler of Evanston, Ill., said. (*Illinois Medical Journal*, September).

It can be assembled for a few cents almost anywhere at any time and is so strong and flexible that a graft has never been known to break. Another advantage of the cow's horn results from its supply of cysteine, in Dr. Fowler's opinion. Cysteine stimulates growth of cells and so adds materially to the healing and union of fractured parts, he points out. He believes the cysteine in the horn is responsible in a large measure for its success in the healing of the injuries without complications and the short time required for the formation of callus at the joining of the bone. — *Science News Letter.*

Study of Anesthetics Key to Mystery of Life and Death — Knowledge of What Happens to Cells of Body When Acted on by Ether or Chloroform Will Give New Light

The mystery of life and death may some day be solved by studies of the effect on body cells of the anesthetics now used to bring oblivion during surgical operations, it appears from the presidential address of Prof. William de B. MacNider, of the University of North Carolina, at the Congress of Anesthetists.

Scientists will come closer to understanding this fundamental problem when they learn more about how ether and chloroform and similar substances affect each kind of cell in the body, Prof. MacNider pointed out.

"We possess in the general anesthetics substances which, by their use and through an understanding of what they do and how they do it, come nearer than any other substances to an answer to the question, what constitutes life and what is the basis for a normal type of death dependent upon functional depression with or without structural changes," Prof. MacNider declared.

In order to pierce the mystery surrounding life and death, scientists need to discover first what happens chemically to the body cells when the patient is anesthetized, and then what happens chemically in reverse direction when the anesthetic wears off and the patient regains consciousness. Prof. MacNider described the anesthetic state as a period of depression in which the body cells in large measure are induced to suspend function.

Discoveries which may lead to a new conception of how the tissues of the body recover from injury and how as a result of that recovery they acquire resistance to further injury by the same or similar substances were reported by Prof. MacNider.

Prof. MacNider called attention to two earlier conceptions of how the body tissues recover from disease. One of these was formulated by the great Russian scientist, Metchnikov, who found that the action of certain wandering cells called endothelial leucocytes provided the body with a means of defense against invading cells like bacteria and also enabled the body to develop resistance to subsequent attacks from these cells. The second theory was a chemical one, formulated by the German bacteriologist, Paul Ehrlich, who found that tissues which were the seat of a disease process produced special chemical antibodies which neutralized or bound the poisons and in that way terminated cer-

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EDITORIALS

PROGRESS IN VASCULAR AERO-MASSAGE

The inadequacy of standard methods of treatment in angiospastic disease forced a number of investigators to attempt measures calculated to increase the circulation in affected vessels in the extremities. The latest ideas are to produce both contraction and dilatation of affected vessels partly to widen the narrowed lumina and partly to prevent serious damage to the surrounding structures. The underlying idea of managing peripheral vascular disease characterized by spasm is to encase the affected extremities in a cylindrical vessel equipped with a mechanism to produce alternations in evacuating and filling the air content in the apparatus. This change in the density of the air in proximity to the affected limb produces a more or less rhythmic contraction and dilatation of the pathologically altered vessels.

Principally this method is new only in a certain form, for it was as early as 1834 that the French physician Junod[1] aroused the attention of the medical world to an innovation which unfortunately enjoyed only a precarious popularity until Bier then of Bonn, gave it a new impetus. Junod ingeniously constructed quite a number of suction apparatus including one to treat the entire human body of which those for use on the extremities received the greatest attention. Junod's idea was that by thinning and compressing the air in boot-like chambers there would result a condition of hemospasia. The underlying concept was far from new, for be it recalled that even before the Hippocratic era, cupping had been in vogue as a fashionable method of overcoming plethoric conditions. Indeed, even primitive peoples used cupping appliances and thinned the air in them by sucking with the mouth.

In the light of the present complicated machinery utilized to overcome vascular spasm, it is of interest to note that four years after his first contribution, Junod[2] reported an improvement of his apparatus by the addition of a thermometer and a manometer to insure proper regulation. In the report to the French Academy he pointed out:

> If the atmospheric pressure over the extremities is reduced the skin becomes red and swelled and the extremity becomes increased in circumference. The inflowing blood produces an unusual warmth, the skin action is greatly increased, profuse sweating takes place, and the ex-

creted moisture quickly evaporates and becomes deposited on the walls of the cylinder. The procedure is followed for a short time by a sense of stiffness and numbness, which however soon disappears. If at the same time warm steam is employed the effect of thinning the air is still greater. There are also observed with this treatment general phenomena such as a light feeling in the head, paleness of the face, slowing of the pulse in the temporal artery, which gradually becomes small and at times lost. There is a tendency to syncope, the respiration becomes easier, intestinal activity is reduced and nausea becomes manifest. Finally the sweating affects the entire skin.

The foregoing description shows that Junod's method was rather heroic, because he withdrew a hazardous amount of blood from the general circulation. It is therefore not to be wondered at that medicine of that period after the first enthusiasm, began to regard the method not devoid of harm. At the same time it is important to point out that Junod ascribed a dilatating effect of his boot only on the capillaries as in fact he claimed that in the treatment of varicose veins their lumen becomes narrowed. In this we see an unconscious foreshadowing of the true physiologic action of hemospasia, which for a long time was regarded as a revulsive procedure in the sense of counterirritation. It must be appreciated that the followers of Junod had to interpret this procedure as a means to remove stagnated blood from a diseased part. The appliances themselves were accepted as substitutes for the ligation of extremities in the treatment of internal hemorrhages, which dates back to the Hippocratic era. We can readily see that such constriction produced a high grade of congestive hyperemia of the extremities. This was interpreted by the French Academy as a beneficial invention because it facilitated the prevention of congestion to vital organs by directing the blood to the extremities.

Perhaps one of the reasons why this valuable method fell into disuse is the circumstance that it was misused and abused. As an example, Ficinus,[3] an enthusiastic follower of Junod, reports that in his apparatus the foot was pressed to the floor with great force and held there as if it were glued. Some of the patients feared that the lower leg would break under the pressure of the atmosphere. Symptomatically there were complaints of a sense of numbness, tingling, burning, intense tension of the skin, especially of the upper part of the treated extremity. Arms so treated retained during the following day a sense of weakness and flabbiness of the muscles. There is no doubt that the intensive atmospheric pressure traumatized the capillaries.

The whole picture is changed through Bier's[4] epochal recognition of the therapeutic value of artificially produced hyperemia and the more recent studies of Gibbon and Landis.[5] Entirely apart from his production of active hyperemia by dry heat and passive hyperemia by gentle elastic constriction, Bier availed himself of Junod's appliance to produce what he termed a mixed form of hyperemia, a form of hyperemia which was not traumatic but reparative in nature. With this underlying idea the labors of Gibbon and Landis opened a field for the hyperemic treatment of vasospastic and arteriosclerotic conditions by demonstrating that local circulation can be improved by means of regulated vascular exercise apparatus. There is no question that the modification of using both suction and compression of air surrounding an extremity enhances local circulation and should therefore prove the method of choice in a large variety of peripheral vascular diseases before gangrene has set in.

While we have already sufficient proof that this method is theoretically sound and clinically effective it will be some time before the majority of general practitioners will be in a position to employ it in their practice. There is reason to advocate hospitalization to insure the avoidance of errors not controllable in private practice. That this is essential is clearly shown by Krusen's[6] clinical observations and research. As Krusen has pointed out elsewhere in this issue, "time must elapse until definite conclusions can be presented," to which we would add that simplification of technic and appliances would materially aid in the attainment of this desideratum.

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HISTOPATHOLOGIC STUDIES OF NASAL IONIZATION

The views held by rhinologists on the problem of nasal ionization are so varied that one sees two extreme tendencies. While some have about decided to throw the whole procedure into the discard, a large number of competent specialists go to the other extreme of enthusiasm about its possibilities. The fact of the matter is that ionization has a place in the therapy of certain nasal conditions, but much work has yet to be done to place it on a sound scientific basis.

Interest in nasal ionization has been stimulated by Warwick's[1] reports on the treatment of hay fever. This author made use of a compound electrolyte in contrast with the simple zinc ionization which had been in vogue. Other workers[2] have suggested modifications in technic, but essentially the present-day procedure is identical with that described by pioneers in this field. Whatever technic one may employ, there can be no doubt that in properly selected cases of nasal allergy ionization has sufficient therapeutic value to merit greater utilization. Hurd,[3] who has recently reviewed the entire subject, claims a high percentage of good results in seasonal hay fever and this without differentiation according to the various technics he employed. In hyperesthetic rhinitis (non-seasonal) over 70 per cent of the patients became symptom-free. These results have been duplicated by other rhinologists in large series of cases. Bryant[4] reports equally favorable results with Warwick's apparatus and technic.

These clinical results would not be fully convincing were it not that histopathologic studies provide a sound basis for them. McMahon[5] studied the effects of ionization on the mucosa of frontal sinuses of dogs. He found that by utilizing a solution of zinc sulphate definite destructive changes were brought about. He noted ballooning, fragmentation and complete destruction of the surface epithelium in many places, marked edema and partial disintegration of the subepithelial tissues with extravasation of free red blood cells from greatly dilated and ruptured capillaries. With a view of detecting even more extensive and lasting changes this investigator[6] undertook a series of experiments from which he concluded:

1. Ionization of the nose of dogs with a solution of zinc sulphate caused a fibrosis of the subepithelial tissues which was seen to be progressively more marked and well established in the animals killed at intervals of from eighteen hours to seven weeks after ionization.

2. Ionization of the frontal sinuses caused a similar fibrosis in dogs killed at seven and twelve weeks, respectively; marked hyperplastic changes in the bone occurred in the dog killed at twelve weeks.

3. The epithelial changes in the nose consisted of primary destruction and later regeneration practically to normal, while in the frontal sinuses there occurred an eventual transition to a cuboidal type of cell over the areas of greatest destruction.

Hollender[7] investigated the histologic changes in patients for the purpose of correlating them with the clinical results of ionization (zinc) in non-seasonal nasal allergy. His histopathologic studies yielded findings similar to those observed by McMahon in animals. Hollender states:

Sections made immediately after treatment revealed changes in the surface epithelium ranging from thickening to partial destruction, but with absence of cilia in every section. Sections taken at different periods after ionization showed gradual regeneration of surface epithelium, first as a squamous cell formation and at three months as a pseudostratified form, the cilia being consistently absent in all sections. The subepithelial stroma revealed a gradual tendency towards structural density with early marked lymphocytic reaction which subsided slowly but persisted in a lesser degree for several years.

These histologic findings undoubtedly show that ionization produces an effect akin to fibrosis, which in all probability accounts for the reduced

turgescence especially in the region of the inferior turbinate, followed by improved ventilation. The length of time during which lymphocytic reaction can be observed explains in part the prolonged palliative effect of ionization.

The above findings permit of certain clinical deductions. A question that arises is whether, as McMahon fears, a condition may not eventually be brought about for which "premature nasopause" seems as good as any description. Clinical and laboratory observations of patients made several years after ionization clearly show such a fear to be groundless. On the assumption that the ultimate tissue changes seen both in animals and humans have been correctly interpreted it is difficult to understand why there should be any apprehension about the late effects of ionization, when we have obtained identical tissue changes with other and more hazardous procedures. While it must be conceded that clinical and laboratory investigations have been carried out in an insufficient time period to permit the drawing of definite conclusions, sufficient evidence has been obtained to justify all rhinologists to avail themselves of ionization in properly selected cases as a valuable measure to afford relief in otherwise stubborn cases. While much work has yet to be done, to place the whole problem on a strictly scientific basis, progress will be achieved only by judicious practice of individual observers. Certainly so applied the rhinologist need have no fear of untoward effects. There is no doubt in the minds of all who have given metallic ionization of the nasal mucosa a fair trial that the procedure has advantages which can no longer be ignored.

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THE FIRST LATIN-AMERICAN CONGRESS OF PHYSICAL THERAPY

Physicians in the United States and Mexico interested in the advances of physical therapy organized an international convention which recently held its first session in the Mexican capital. Most of the American members who live in the east made this "good-will" trip by steamship, which proved an enjoyable means of taking a sight-seeing holiday.

The Mexican government extended many courtesies to the thirty-four American delegates from the moment they arrived at Vera Cruz until they were again homeward bound. In all, the journey by sea, the convention and the sight-seeing tours lasted about twenty days.

The scientific session was opened by the Honorary President, Dr. José Sizirol, Chief of the Mexican Health Service, in the palace of fine arts. Clinical sessions were held in the General Hospital, the Emergency, the Morales Hospital for Social Diseases, to which should be added a tour of inspection of the Rockefeller Foundation Experimental Station for Rural Hygiene under the direction of Dr. Charles A. Bailey. The American delegates were impressed by the architectural contrast, for these hospitals have been located in parks and constructed on the two-story pavillion systems, a style of architecture found suitable for sub-tropical countries.

Papers read by the American delegates included one on a special eye electrode for vernal catarrh by Frances Richman. Artificial fever was discussed by Heinrich Wolf. Changes in skin surface temperature under short wave treatment were demonstrated by William Bierman. New low voltage apparatus and diathermy electrodes were described by Franz Nagelschmidt. Electrosurgical demonstrations were held by C. L. de Victoria. Electrocoagulation of tonsils was treated by L. L. Doane. Measurements of x-rays by a new method were presented by Gustav Bucky. Other speakers were

Albert Bachem, F. J. Melnick, George A. Ornstein, Oswald S. Lowsley, and Herman G. Scharman (Director of Wyckoff Hospital, Brooklyn). The presidential address entitled "International Cooperation in Physical Therapy" was delivered by Norman E. Titus, New York. Motion pictures dealing with several phases of physical therapy were shown at the Palace of Fine Arts.

Lack of space prevents us from giving an adequate description of the hospitality extended by our Mexican colleagues and high officials of the Mexican government. It must suffice here to state that the delegates were afforded ample opportunity to visit many historically important places in Mexico, as well as those of exquisite scenic beauty. Of especial interest is the fact that this first international convention has strengthened the bonds of friendship and scientific alliance between the two neighboring republics. The fact that already plans have been laid for another and larger Latin-American congress is proof that our Mexican colleagues have become deeply interested in the clinical importance of scientific physical therapeutic methods.

Research in Radioactivity Spurred by New Principle

A new principle of separation of man-made artificial radioactive elements from the normal substances, from which they are produced, is announced (*Nature*, Sept. 22). The discovery is expected to speed research in the field of atomic studies of how the smallest unities of matter are composed.

Drs. Leo Szilard and T. A. Chalmers of the physics department of famous St. Bartholomew's Hospital of London describe a method, which they call "a new principle of separation," for concentrating an artificially produced radioactive element even in the case where the radioactive element is an isotope of the original element.

Thus, for example, by bombarding iodine crystals with neutrons it is possible to produce a radioactive form of iodine but it has hitherto been impossible to separate it from the iodine crystals in the original target because both the radioactive form of iodine and the normal form are isotopic. Chemically isotopes are indistinguishable.

The London scientists report that now they have found a way of separating the two forms of iodine.

Their method is based on the following reasoning:

1. It is logical to expect that atoms of an element struck by neutrons in atomic collisions should be removed from the compound. These impacted atoms frequently are radioactive.

2. Around the target, therefore, would be a swarm of struck-atoms. But normally there would be a constant interchange between these free radioactive atoms and the normal non-isotopic atoms still in the target. Experiments should thus show, as they do, that part of the radioactivity is still in the material of the target.

3. BUT — if the impact experiments are carried out under conditions in which this interchange is impossible or considerably reduced, it should be possible to obtain the "free" radioactive element. Chemical changes like reduction and precipitation might then be able to remove the radioactive atoms permanently from the scene.

In analogy the trick would seem to be that by controlling the conditions of the experiment a "one-way street" is created, in a chemical sense, along which radioactive atoms can travel Their return, however, is prevented. One might think of the "street" as a hill down which balls can roll but not come back.

In experiments with iodine- compounds Drs. Szilard and Chalmers used a vapor of pure iodine as the blocking condition which prevented, considerably, the radioactive atoms from rejoining the target of ethyl iodide. The pure iodine somehow protected the radioactive isotope, they say.

The method should be especially valuable for the many radioactive experiments on elements having atomic numbers higher than 30. Below atomic number 30 artificial radioactivity produced by neutron impact commonly creates substances having different chemical properties. Thus a radioactive gas may be created from a solid element, just as radon gas is produced by naturally disintegrating radium.

Above atomic number 30, however, — as in the case of arsenic, bromine, iodine, iridium and gold — radioactivity can be produced, but most of it still stays in the target. Its presence can be detected but it is most difficult to concentrate it. The new British method appears to solve this baffling problem. For iodine, it is reported, a concentration of the radioactivity ten times more than normal has been achieved. — *Science News Letter.*

SCIENCE, NEWS, COMMENTS

(*Continued from page 618*)

tain diseases and imparted resistance to further attacks.

The part played by the fixed tissue cells of the body, such as are found in the skin, the eyes, the liver or the kidneys, in inducing resistance to disease has been investigated by Prof. MacNider. He found that in case of slight injury these cells repair themselves by formation of a normal type of cell having normal function but no resistance to the same kind of injury. But if the original injury is severe, in a certain number of instances the repair process results in formation of an abnormal type of cells, which may or may not have normal functional value. Such cells, however, are not only highly resistant to the chemical substance which caused the injury but to a variety of other chemical poisons.

Study of the rôle of the fixed tissue cells in giving the body resistance to injury by invading forces is just beginning, Prof. MacNider said. His investigations were made on the liver and kidneys. Their results and implications add further to the knowledge of how the body protects itself against injurious substances. — *Science News Letter*.

Man-Made Gamma Rays Six Times as Piercing as Nature's

Man-created gamma radiation, of the kind so widely used in the treatment of cancer, and excelling the best efforts of nature over six times, is being studied at California Institute of Technology.

Four scientists, headed by Prof. C. C. Lauritsen, of the Kellogg Radiation Laboratory, report in the *Physical Review* (July 15) that they have unmistakable evidence of laboratory-produced gamma rays having energies of 16,000,000 electron volts. The highest energy found in natural gamma rays — given off by radioactive substances such as radium — is only 2,600,000 electron volts, an energy "record" held by the radioactive element known as thorium C.

Prof. Lauritsen's 16,000,000 electron volt gamma rays were obtained in experiments performed in collaboration with Dr. H. R. Crane, Dr. L. A. Delsasso and W. A. Fowler. The light metal element lithium was bombarded with protons, the positively-charged nuclei of hydrogen atoms, to yield the piercing rays.

The proton atomic "bullets" were driven down a special vacuum tube, in the research, by electric voltages which ranged from 400,000 to a million volts. On striking the lithium target, the proton is believed to combine momentarily with lithium atoms.

The lithium atoms, the investigators report, are thought to be the isotopic form of mass seven. When a proton joins them, it adds its mass of one so that the total mass is eight.

The 16,000,000 electron volt gamma rays which emanate from the union are best explained by assuming that the lithium and proton of total mass eight break up into two helium particles, each of mass four. Such helium nuclei are known as alpha particles and, along with gamma rays and electrons, are given off when radium disintegrates.

To balance the queer-looking energy equation, it is necessary to postulate that 17,000,000 electron volt gamma rays come out when the two alpha particles are created.

The presence of 16,000,000 electron volt rays was detected quite definitely by a study of the atomic "debris" knocked out.

Tracks of the flying electrons from the impacted atoms of the lithium target were observed in a Wilson cloud chamber in the investigation of the high energy gamma radiation. — *Science News Letter*, July 27, 1935.

Sterilization Wrong Approach to Feeble-minded Problem

Sterilization will not solve the Problem of mental deficiency on either economic, eugenic or humanitarian grounds, in the opinion of Dr. Lionel S. Penrose, research medical officer of the Royal Eastern Counties Institution at Colchester, England.

The menace of the feeble-minded is a question of very moderate dimensions when put in its true proportion to other problems, Dr. Penrose points out in his recently-published book, Mental Defect (Farrar & Rinehart).

On the economic side, Dr. Penrose states that it might cost the state as much as four million pounds to provide institutional care for all the mentally defective in England who need it. But it would be possible to cope with the whole problem of mental deficiency in that country by a comparatively small reduction in the hundred million pounds or so spent annually on the fighting forces.

Only 5 per cent of the next generation of mentally defective persons would be prevented if all existing mentally defective parents were compulsorily sterilized, Dr. Penrose says.

"Furthermore, a large proportion of existing defectives never could have children because their mentality is of such low grade that they would never, in the ordinary way, find a mate," he states.

The only defectives whom it would be worth while sterilizing are those of high enough mentality and complete enough physique to enable them to have offspring. But even these defectives can not, under present economic conditions, earn their own living. Sooner or later they drift into institutions and they would do so whether sterilized or not.

Of the slightly higher grade of defectives, those having a mental age of nine years or more, there is the serious difficulty of determining whether

they are or not defective. Many authorities consider this mental age the borderline. Undoubtedly these persons make poor parents, but even here the problem is solved by itself without recourse to sterilization, Dr. Penrose indicates. These persons generally come to the attention of the authorities because of behavior difficulty and as soon as they are thus discovered, they are put under institutional care.

Finally, Dr. Penrose questions the humanitarian views of those who advocate sterilization of mental defectives.

"At the back of the minds of many people is the notion that sterilization should be a punitive measure," he declares.

"It has been pointed out that the advocates of sterilization never wish it to be applied to their own class, but always to someone else. — *Science News Letter,* January 12, 1935.

Substitute for Morphine Found After Long Search

After years of painstaking research, scientists have produced a new derivative of morphine in the course of experiments directed toward the discovery of a non-addicting form of morphine.

Dihydrodesoxymorphine-D is the name of the new drug. It was made by Dr. Lyndon F. Small, University of Virginia research chemist. It is ten times as effective as morphine in relieving pain.

Given as a substitute for morphine to persons addicted to the latter drug, the new product satisfied the cravings of the addicts and relieved the painful abstinence symptoms that follow withdrawal of morphine. This indicated that it also might be habit-forming.

Tests with monkeys and other animals indicate that these animals develop tolerance to the new drug as they do to morphine. It is not certain, however, that experiments on monkeys are a correct index of the new drug's addiction or habit-forming property for man.

The final test of this point is now about to be made. Patients suffering from severe cancer and advanced tuberculosis are sure to become addicted to morphine, because that is the only drug which will control their pain and cough. A group of such patients will soon be given the new drug instead of morphine to relieve their suffering. If they fail to develop addiction to the new drug, dihydrodesoxymorphine-D will be hailed as the long-sought, safe substitute for morphine, and possibly as an aid in the prevention of narcotic drug addiction. If it can be used in the case of persons already addicted to narcotic drugs, it might aid in their "cure."

Since Dr. Small can produce only a limited amount of the new morphine in his laboratory, he has patented his discovery and given the patent rights to the Secretary of the Treasury. The Commissioner of Narcotics is now able to license manufacturing firms to produce enough of the new drug to complete the clinical trials.

The discovery of dihydrodesoxymorphine-D was the result of a concerted attack on narcotic drug addiction by several groups of scientists working under the guidance of the National Research Council. Cooperating with the National Research Council's committee have been the U. S. Public Health Service, the Narcotic Bureau of the U. S. Treasury, the University of Michigan and the University of Virginia. Members of the National Research Council drug addiction committee are:

Dr. William Charles White, National Institute of Health, U. S. Public Health Service, chairman; H. J. Anslinger, U. S. Commissioner of Narcotics; Prof. Charles W. Edmunds, University of Michigan; Dr. Ludvig Hektoen, Director, McCormick Institute for Infectious Diseases; Prof. C. S. Hudson, U. S. Public Health Service; Prof. Reid Hunt, Harvard University; Dr. Frederick B. LaForge, Bureau of Chemistry and Soils, U. S. Department of Agriculture; Prof. Torald Sollmann, Western Reserve University; Dr. Walter L. Treadway, U. S. Public Health Service; Prof. Carl Voegtlin, National Institute of Health, U. S. Public Health Service; and Prof. Francis G. Blake, Yale University, chairman of division of medical sciences, National Research Council.

At the University of Virginia a research laboratory was established under Dr. Small's direction for chemical analysis and synthesis of alkaloid substances related to or similar to morphine. Because few American chemists had worked on alkaloid chemistry in the past 25 years, it was necessary at the start of the work to import chemists from Europe for Dr. Small's laboratory. Dr. Small himself spent two years in narcotic research in Europe. The "imported" chemists who have worked with him are Dr. Erich Mosetting and Dr. Alfred Burger.

At the University of Michigan another research laboratory was established under the direction of Prof. C. W. Edmunds and Dr. Nathan B. Eddy, for biological testing of the narcotics and their substitutes.

All clinical work is being done under the direction of Dr. Walter Treadway, chief of the division of mental hygiene, U. S. Public Health Service.

Funds for the work are being provided by the Rockefeller Foundation. — *Science News Letter.*

Those Most Sensitive to Electricity Stand Shock Best

Just as some persons see better than others, some animals are able to withstand electric shocks — seemingly without injury — that cause other animals to suffer permanent harm.

This is one of the discoveries of Dr. W. B. Kouwenhoven, Johns Hopkins University electrical engineering professor, who with a group has been investigating the effect of electric shocks with the ultimate purpose of saving human lives and making the use of electricity safer.

One seeming paradox which he reported to the New York Electrical Society is that rats most sensitive to small amounts of electricity have the

greatest resistance to electric shock.

This bears out the experience of electrical workers and linemen in the field, Dr. Kouwenhoven said. Electrical workers found that those among them who feel the weakest currents are best able to withstand and recover from strong shocks. The reason for this resistance of sensitive individuals has not yet been discovered.

The relation of resistance and sensitiveness to electricity was discovered in the course of studies which have been made on rats. In one experiment the animals were placed in a basket through the bottom of which a weak electric current was passed. At first the rats did not seem to notice the electricity. Then as the amount was gradually increased, some of the animals stopped feeding and jumped out of the basket. Others did not interrupt their feeding until a stronger current passed through the grid at the bottom of the basket.

The rate were divided into two groups, sensitive and comparatively insensitive. Dr. Kouvenhoven and his associates expected the more sensitive animals to suffer greater injury from a stronger electric shock. To their surprise, the sensitive animals showed the greatest resistance.

Best method of reviving a person shocked by electricity is the Shaffer prone pressure method of artificial respiration, which is also used to revive victims of drowning accidents and gas poisoning. The artificial respiration should be started as soon as possible, Dr. Kouwenhoven said, and should be kept up until rigor motis, the stiffening or rigidity which follows after death, sets in. This is because the heart may be beating enough to keep the brain and the rest of the body alive even when beating so feebly that its pulsation cannot be detected by a stethoscope, he explained.

The danger of death from electric shock from the ordinary household current was stressed by the scientist. He and his associates found that alternating current is much more dangerous at low voltages than at high voltages. On high voltages the muscle contraction may be severe enough to throw the person away from the contact with the electricity, while on low voltage circuits it is often impossible for him to let go. Low voltage direct current is not nearly so dangerous as low voltage alternating current. There is only one authentic record of a man being killed by 110 volts from a direct current circuit, but there are many such deaths from the 110 volt alternating circuits. The danger from household circuits is particularly great in bathrooms, cellars, garages and other damp places.

Never reach for an electric device while in the bathtub or while still wet from the bath, Dr. Kouwenhoven warned. Don't use an electric curling iron in the bathroom. He noted with approval the Massachusetts law which forbids placing electric switches inside the bathroom. Neither switchplates nor pull sockets should be within reach of the bathtub, and there should be no electric heaters in the bathroom.

Low voltage shocks kill because of their effect on the heart, the Johns Hopkins scientists have found. The low voltage current puts the heart into the state called fibrillation, which means that the heart fibers, instead of all contracting together as a unit, contract separately. The force of these separate contractions is not great enough to pump the blood and the animal soon dies. A strong shock will stop the heart action all at once, it was found, and the victim may then be revived by artificial respiration.

Dr. Kouwenhoven and associates have found a strong counter-shock will stop the fibrillation caused by low voltage shocks and give the victim a chance to be restored. However, he has so far applied this method only to animals.

They have in this way revived animals dead of electric shock for as long as five minutes, but after five minutes, while the heart action can be started, the animals die. The reason for the failure, Dr. Kouwenhoven believes, may be that the nursing given after the heart action started was not good enough. Since animals can not tell how they feel, it is difficult to give them the efficient nursing care that can be given human patients. — *Science News Letter.*

Beer Fattens Because It Is Food as Well as Drink

If you are undernourished and feel that beer will build you up, medical science is prepared to recommend that you add the beverage to your usual diet.

You can silence your critics by the scientifically attested statement that it is not only the alcohol in the beer that is building up your weight. The Journal of the American Medical Association (Dec. 21) says editorially that only half of the calories in German beer are derived from alcohol; the rest come from "dextrin and protein-like extractives" in the beer. Here is food material "whose fattening properties may be very highly considered," according to one medical authority cited in the Journal editorial.

The editorial calls attention to the alcoholic content of domestic beers which were analyzed before and after repeal. Thirty-seven light beers analyzed before repeal had an average alcoholic content of 3.7 per cent. The maximum content was 4.64, and the minimum 3.01. Often light beers (many of the brands included in the earlier analysis) the average alcohol by volume was 4.64 per cent, the maximum 5.23 and the minimum 4.02. — *Science News Letter,* January 19, 1935.

Vitamin B_4 Found to Fight Anemia

Vitamin B_4 apparently can prevent anemia by stimulating formation of red blood cells, Drs. Jean L. Kyer and Frank H. Bethel of the Simpson Memorial Institute, Ann Arbor, Mich., reported to the American Society of Biological Chemists.

The anemia in this case is not pernicious anemia but the kind known as nutritional anemia. Other parts of the vitamin B complex, which is made up of at least four vitamins, were not effective in preventing anemia, experiments with rats showed. Vitamin B_4 may play its important antianemic role by influencing the production of hemoglobin, the coloring matter of blood. — *Science News Letter,* April 27, 1935.

Six Hundred Billion Volt Cosmic Rays Predicted by Prof. Arthur H. Compton

Where do the enormous energies observed in cosmic rays come from? Newest of all problems in atomic science is to figure out how the ray energy is released.

Cosmic rays have been observed, for example, so energetic and piercing that they pass through nearly 2,000 feet (600 meters) of seawater.

Prof. A. H. Compton, American Nobelist now at Oxford University, England, has published an estimate *Nature* (Jan. 12), that some of the most piercing cosmic rays have energies of 600,000,000,000 electron volts.

Such great evidences of energy, Dr. Compton points out, cannot come from the release of the energy equivalent to the mass of most atoms known on earth.

It would require atoms from 100 to 1,000 times as heavy as those of hydrogen to produce such rays by exploding. Heaviest of all atoms on earth are those of uranium, weighing only about 238 times as much as hydrogen.

Dr. Compton pictures such rays as primary ones coming in from outer space and not as secondary ones created in the earth's atmosphere. They cannot, definitely, be photons of radiations.

Photons are the little so-called packets of radiation, of which ordinary light is only one kind, which have been suggested as the cause of cosmic rays. Dr. Compton's 600,000,000,000 volt cosmic rays, by contrast, are thought to be electrified particles.

Those scientists who like to retain the idea of cosmic rays being photonic in nature have speculated on complex chain reactions within matter as cosmic rays pierce. Such chain mechanisms seek to explain how super-penetrating power of the rays is possible with photons far less energetic than observations would indicate.

Just before Dr. Compton's report, and also in *Nature,* H. J. Bhabha, Indian physicist now at Cambridge, England, described such a hypothetical chain mechanism.

Physicist Bhabha pictures an incoming cosmic ray photon striking atoms of matter and turning into a neutron with little loss of energy. The neutron, like a microscopic billiard ball, flies forward with great energy and with little ionizing power. In traveling through a yard of lead, Mr. Bhabha estimates, some 25 such interchanges between photons and neutrons would occur; the one turning into the other alternately.

This scheme would lower materially the loss of energy as a cosmic ray goes through matter, for about half the time it spent in the material it would be in the form of neutrons and lose little energy. Thus the final power of the ray, as measured by its ionization, would be much more than its real energy if such a mechanism were not acting.

Says Dr. Compton discussing such chain mechanisms, "The apparent absence of any possible mechanism whereby such a chain reaction might be effected seems sufficient to rule out such suggestions." — *Science News Letter,* January 26, 1935.

"Reach for a Sweet" Is Latest Scientific Advice

The old slogan about reaching for a cigarette instead of a sweet may be all right for those who want to lose weight but for those who want to do some heavy thinking, it should be reversed.

Experiments showing that the brain gets its energy for thinking from glucose or sugar were reported to the American Physiological Society by Drs. H. E. Himwich and J. F. Fazikas of Yale University.

The brain takes sugar from the blood, breaks it up into simpler chemical combinations, and burns the lactic acid thus obtained to get energy just as a steam engine gets its energy from burning coal, Dr. Himwich explained.

He and his associate found accidentally that when nicotine is mixed with brain tissue in a flask, the brain cannot burn lactic acid but the burning (oxidation to the chemists) goes on just the same if glucose is present. So it appears that the brain has two ways of getting energy for thinking from glucose or sugar. Ordinarily it gets the energy via lactic acid, but if this is impossible, it gets the energy directly by burning the glucose.

The amount of nicotine that gets to the brain when a cigarette is smoked, however, is probably too small to affect the burning of lactic acid, Dr. Himwich explained. Incidentally, nicotine is not responsible for the increased sugar in the blood caused by tobacco smoking, Dr. Ephraim B. Boldyreff of Battle Creek Sanitarium reported. — *Science News Letter,* April 27, 1935.

THE STUDENT'S LIBRARY

ELECTROTHERAPY AND LIGHT THERAPY. By *Richard Kovács*, M.D., Clinical Professor and Director of Physical Therapy, Polyclinic Medical School and Hospital, New York; Physician in Charge Physical Therapy, City Hospital, New York; Visiting Physiotherapist, Manhattan and Harlem Valley State Hospitals and West Side Hospital; Consulting Physiotherapist, Hackensack Hospital and Mary Immaculate Hospital, Jamaica, New York. Second Edition, Thoroughly Revised. Illustrated with 263 Engravings and a Color Plate. Cloth. Pp. 696. Price $7.50 (plus tax). Philadelphia: Lea and Febiger, 1935.

The second edition comes as an agreeable realization of expectations with regard to revisions and inclusion of new, timely and pertinent material. The author has not only maintained in his present exposition all of the splendid qualities noted in the earlier work but has incorporated the necessary information to make it an outstanding contribution for both students and practitioners. Kovács points out that, "while in the first edition the selection of data was often necessarily a compromise between generally accepted and clinically demonstrable facts and pertinent laboratory and experimental observations, most of the new material added has been drawn from the latter group of sources." One notes that the chapter on Introductory Physics has been rewritten in a style of easy understanding; there has been added a new general chapter on the physiologic effects of electricity; a detailed description of iontophoresis in arthritis; discussions of hyperpyrexia by all of the present accepted methods; a new chapter dealing with short and ultrashort wave therapy. One observes that the chapters on light therapy have been completely rewritten and enlarged. The author has also included a great deal of new information under the section of applied therapy, such as proctology, electrosurgery in urology, ophthalmology and various other conditions. Under the circumstances it is pleasing to note its increased bulk, and the retention of that portion of the work in the earlier edition which received such favorable comment.

As a matter of constructive criticism it should be pointed out that the present work suffers from lack of literary precision. In a scholarly effort such as this, one is disappointed to find occasional literary lapses. Since precision is a *sine qua non* of scholarship, the author should have been careful in the spelling of names. Thus the name d'Arsonval appears at the beginning of a sentence (page 219) with a small "d". The name of Keesey is thrice given as Kelsey (pages 138 and 598) and in the index. It is also questionable whether the author's doubt about the efficacy of Keesey's method of treating hemorrhoids by galvanism in the sense of requiring further proof is justified, for he should know that it has been given adequate trial by a number of competent observers in the largest hospitals in Chicago with excellent results in properly selected cases. A similar indifference in expression is found on page 490 and elsewhere, in which the author dismisses problems advanced by no less an authority than Schliephake as "awaiting corroboration." Here one may expect a definite stand of an author teaching a subject which is already common property. In science, straddling the fence is not considered a dignified way of handling even moot problems. On the same page we note the expression that a diathermic current may be "directed through the area of pathology" — a solecism not in keeping with literary usage. Good scholarship presupposes correctness of bibliographic references. We find that this rule has been observed in the breach, *e.g.*, page 304, reference No. 15. These examples could be multiplied, but sufficient has been shown to justify the statement that the work should have been more carefully edited, especially in sentences which are either contrary to accepted teachings or do not lucidly convey information. What has been pointed out, however, does not detract from the value of the work, because in its all inclusiveness it is unquestionably the most representative text on the various branches of physical therapy.

SHORT WAVE THERAPY. By *Erwin Schliephake*, M.D., Privatdozent for Internal Medicine at the University of Jena. Authorized English Translation by *R. King Brown*, B.A., M.D., D.P.H. From the Second and Enlarged German Edition. With Foreword by *Elkin P. Cumberbatch*, M.A., M.B., B. Ch. (Oxon.), F. R. C. P. (Lond.), D. M. R. C. (Camb.). Cloth. Pp. 250 with 94 Illustrations. Price $5.50 net. London: The Actinic Press, Ltd., 1935.

Schliephake's original monograph is so valuable an exposition of all problems pertaining to short and ultrashort wave therapy, that a translation for English-speaking medical men is not only timely but a realized desideratum. Translations are always a difficult task and can be successful only when the translator masters the original idiom in order to be able to convey in the new tongue every shade of meaning in the original text. For this a pure dictionary translation is entirely inadequate. Comparison of the present volume with the original shows that Dr. Brown has done a good job, though in many places the fluency of the German expression is somewhat marred. Certain sections contained in the original, which are of great interest to earnest students, have for some unaccountable reason been omitted in the translation. Nevertheless, the service rendered by Brown is invaluable to all who are unable to read German, for this is the first presentation of the work of one of the most noted pioneers in the domain of short wave therapy that is accessible to them. It is regrettable that the pub-

lishers have failed to reproduce the German format, which represents the best in the art of printing and bookmaking. We note with pleasure that the translator has placed a "Clinical Index" in the front of the book, which materially assists the reader in quickly finding any desired subject, a feature absent in the original. Cumberbatch, known to our readers as a distinguished representative of physical therapy in Great Britain, has written a conservative yet stimulating foreword. We are in accord with him when he states, that "those who doubt whether the results obtained by shortwave treatment could not have been procured by diathermy should make a careful perusal of Dr. Schliephake's book," as we are that "it contains a wealth of material which will interest the scientist as well as the physician." Certainly, the translation enables many who have received information about Schliephake's works by abstracts in the literature and who have adopted an attitude of skepticism of his striking therapeutic results to become intimately acquainted with the author's successes and failures and thereby revise whatever erroneous impressions they may have at first been given.

DR. BUNDESEN'S DIET BOOK. The Safe Way to Reduce. By *Herman N. Bundesen*, M.D. Cloth. Pp. 158. Illustrated. Price $1.50. Chicago: The Reilly & Lee Co., 1934.

So many popular books on dieting have been written for the public without a scientific background and so many others have been written in a language which the average layman or rather lay woman cannot understand, that every physician should welcome this addition to popular dietetics. The author is too well known as an authoritative sanitarian to need introduction. For many years the health commissioner of Chicago, he has toiled hard and extremely successfully to preserve the health of his community. His activities to protect the health of infants have aroused world wide admiration, as is evidenced by many imitations of his measures in countless communities both here and abroad. It hardly needs pointing out that whatever data Dr Bundesen has given in the present little book are scientifically correct. But the principal value of the book lies in the way the author has submitted them for popular consumption and — digestion. One cannot imagine even the most indifferent reader perusing the very first page without being sufficiently interested not to lay it down until the entire text has been read. The book is more like a friendly conversation between a doctor knowing human nature and a patient willing to learn, if the learning does not require mental effort. Wit, humor, and satire are intermingled with good sound advice, and a number of caricatures full of meaning graphically tell weighty stories occasionally even without a legend. The book has many charts and tables, 28 banana and skimmed milk menus, 30 reducing menus and an equal number of maintenance diets. The last (fifteenth) chapter entitled "how to weigh" is really a mild preachment advising readers who think they are stout to first find out whether they actually need reducing or not. Here is at last an inexpensive, attractively printed diet book, which, though reading almost like a novel, contains the kind of advice every physician can confidently place in the hands of interested patients. But even physicians will find both recreation and valuable information by a few hours spent in its perusal.

KLINIK UND THERAPIE DER ALLERGISCHEN KRANKHEITEN (Diagnosis and Therapy of Allergic Diseases). *By Dr. Erich Urbach.* Privatdozent of Dermatology University of Vienna. First Assistant at the University Clinic for Sexual and Skin Diseases in Vienna. Cloth. Pp. 781 with 302 illustrations (26 in colors). Price 30 Marks. Vienna: Wilhelm Maudrich, 1935.

The medical world owes Urbach a great debt for this encyclopedic work. One needs only to consider the obscurity that still prevails about sensitivity, anaphylaxis and in fact about all problems of pathergy affecting a vast number of diseases of every part and organ of the human economy to appreciate the importance of a work which sheds much light in a field heretofore inadequately understood and improperly managed. Urbach has not only carefully systematized this entire domain but has lucidly explained many obscure problems.

The reviewer confesses his inability to do full justice to this important work. Since von Pirquet, in 1902, dimly realized the nature of reaction by observing it in a child to whom serum had been administered and, four years later, coined the term "allergy" for certain types of sensitivity, the literature on allergy has grown to such dimensions and is so dispersed among specialistic publications that its collection alone is a task beyond the power of any one author. Yet the author has not only achieved this great labor but has completely organized every problem and every affection in which allergy plays a rôle, to which he has brought the fruits of his own clinical research as well as that of other workers.

We have not space enough even to enumerate the titles and subtitles of the diverse chapters of the book. We therefore point out that this study is divided into a general and a special part. In the former the author discusses the various types of oversensitivity and undersensitivity, experimental anaphylaxis research, the pathogenesis of allergy, the antigens, antibodies and the chemism of allergy, allergic predisposing factors, the tissue manifestations of allergy, the technic of demonstrating allergens and methods of their production as well as that of extracts. In fact allergic therapy is fully covered in this part of the book in a general way. The subject matter contained in the special part, which is essentially clinical in character, is opened with a discussion of anaphylactic shock, the angioneurotic symptom complex, and angioneurotic edema. This is followed by bronchial asthma, eye diseases, many skin diseases, vascular and cardiac diseases, gout, infections, joint affections and many others in which allergy plays an etiologic rôle. Of especial interest to our readers will be a chapter on light sensitivity manifesting itself as skin lesions which are often mistaken for ordinary types of eczema. This chapter is well illustrated, so that in

connection with the text mistakes may be obviated. In this chapter one will also find that the author's therapy is not one-sided, as indeed he is careful to point out the need for searching out other than allergic causative factors. Of especial theoretic interest is also a chapter on allergy in cancer. Here the author completely upsets certain claims made by researchers and shows by experimental work undertaken with Wiedmann, that unspecific defense bodies against malignancies can be stimulated by functional irritation of the reticulo-histiocytic system, as for example by radiation with weak x-rays. Again one will find much food for thought when reading that a number of physical agents (diet, certain baths, irradiations and the like) play an important rôle in the treatment of many allergic diseases. Nor has the author failed to repeatedly stress the problems of prophylaxis. The text proper concludes with a section on allergic diseases of animals, a subject of importance to physicians. Finally concentration tables for eczema tests and a lengthy questionnaire for patients are given as an appendix. A subject and an author's index facilitate orientation in the mass of information contained in the text. Paper, print and binding are of the highest quality. Here, indeed, is a book which should be translated in every living language for the benefit of science and humanity.

THE ANATOMY OF SURGICAL APPROACHES. By *L. C. Kellogg*, A.B., M.D., Professor of Anatomy, College of Medical Evangelists, Loma Linda and Los Angeles, California. Cloth. Illustrated. Price, $1.50. Pp. 134. Baltimore: William Wood & Company, 1934.

While there is no dearth of books on surgical anatomy it is a fact that the young surgeon will find little in them of help in avoiding pitfalls in making incisions to reach blood vessels, nerves, or deep structures and organs. This long felt need is filled by the present small and inexpensive book, which is bound to enjoy a wide popularity among surgeons and general practitioners. The art of incising even for minor ailments or injuries is an important one since each region of the body presupposes correct anatomic considerations for exposures. While a good deal of information is contained in the larger anatomic and surgical works, it is presented casually and inadequately. Kellogg has not only succeeded in collecting all needed information and presenting the rationale for certain methods of surgical approach, but has added a number of procedures which are original and therefore not found in standard textbooks. The book is divided into four parts dealing with the upper extremity, the head and neck, the thorax and abdomen, and the lower extremity in the order given. Ligation of arteries, exposure of nerves, general operative incisions, paracentesis of the pericardium, resection of ribs, tracheotomy, high and low, approaches to joints, and incisions to establish drainage for infections are a few of the subjects treated in individual chapters. This must suffice to convey an idea of the subject matter expatiated in the meaty little book. The descriptions of the procedures are not only authentic but leave nothing to conjecture. They are enhanced by 29 drawings which clearly illustrate many operative steps, especially dissections. Indeed, the book is indispensable to every general surgeon and occasional operator.

INTERNATIONAL ABSTRACTS

What Practitioners Should Know About Physics and Technic of Short Wave Treatment. (Was der Praktiker von der Physik und Technik der Kurzwellenbehandlung wissen soll.). J. Kowarschik.

Aerztl. Praxis **8**:312 (Dec.) 1934.

The author emphasizes the fact of equal methods in the production of short wave currents and long wave currents of diathermy, by spark gap machines over which condensers are discharging on the one hand, and by thermionic valve machines. Spark gap machines provide promptly damping and intermittent oscillations, thermionic valve machines provide constant oscillations of equal amplitude. The current of spark gap machines presents a mixture of waves with one (fundamental) wave predominating, the current of thermionic valve machines reveals but one fixed wavelength. The wavelength of currents supplied by spark gap machines is fluctuating according to the size and shape of the part of body exposed. The wavelength of the thermionic valve machines is almost constant. Spark gap machines are less economic, consuming a more intense energy with equal work. Thermionic valve machines are more economic, as they require a smaller amount of energy. On the other hand spark gap generators are extremely durable while the tubes must be replaced by new ones after 1,000-3,000 burning hours. In radio technics spark gap machines were altogether given up as oscillation generators, electronic tubes being used exclusively. In electromedicine, physicians are more conservative, still employing spark gap machines for short wave treatment. This is partly due to the fact that only a few firms are permitted to make thermionic valve machines, all other manufacturers being producers of spark gap machines only.

Short waves may be applicable in three ways:

1. By metal electrodes applied to the skin directly, as in diathermy, in order to obtain a marked deep effect, but with a greater risk of skin burns as is the case with diathermy.

2. In the electric or condenser field (Schliephake) when the electrode is separated from the body by an insulating space of variable size or by an insulating layer. That distance must at least be 1-1½ cm. otherwise an intense heat effect is at the surface only, while the deep heating is far from being sufficient. Such intervals are obligatory for obtaining an even penetration of the body. It must be emphasized that spark gap machines, because of their small output, cannot produce any stronger resistance as required by a large interval between the electrode and the body.

3. In the electromagnetic field or coil field, (Kowarschik), when the part of the body under treatment is embedded in a metal coil. In this procedure, too, an insulating layer of sufficient extent must separate the body from the turns of the coil.

Indications and Results of Short Wave Therapy in Surgery. (Anzeigenstellungen und Ergebnisse der Kurzwellenbehandlung in der Chirurgie.) Alfons Lob.

Munchen med. Wchschr. **81**:1812 (Nov.) 1934.

Production of heat in the tissue causes prolonged hyperemia by which certain biologic phenomena are developed. There is some divergence between the experiences of the author with short wave diathermy of surgical diseases and those given in the literature. There is an absolute contraindication to short wave treatment with acute pyogenic tendon sheath phlegmon, with acute pyogenic osteomyelitis and with acute infectious joint diseases. With carbuncles the author prefers electrosurgical operation to short wave treatment. For furuncles of the nose and upper lip and erysipelas, x-ray irradiation was superior to short wave treatment. With pleural empyema short wave treatment may be suggested only after removal of the pus by puncture or incision. On the other hand with non-purulent exudates we may avail ourselves of the influence the short waves exert on resorption.

Beneficial results from short wave diathermy are obtainable with subacute and chronic surgical infections, particularly subacute tendovaginitis, erysipeloid and chronic-purulent osteomyelitis.

Experiences in treating tuberculous joints were not encouraging. Among tuberculous diseases some exudative types of peritonitis offer the best chance by treatment with short waves. Success in the resorption of the exudate is secured when the treatment is carried on for a sufficient length of time.

In using short wave diathermy for the treatment of non-inflammatory joint diseases, the chance for success is most promising. Injuries of the joints with hemorrhage or effusion are offering a field of usefulness. Short wave treatment is also effective in all injuries of the capsule and ligaments (sport). Good results are produced with the short wave treatment of humeroscapular periarthritis.

In neuritis and neuralgia alleviation of pain is readily obtained, especially in sciatica and occipital neuralgia. There is no influence whatever on serious trigeminus neuralgia (tic douloureux.)

In many postoperative conditions, short wave treatment offers effective support to after care, especially after primary and secondary sutures of a tendon, phlegmon of a tendon sheath and other types of inflammation of soft parts. It effects ease of the sense of tension in cicatrices after operations which entail subacute infiltrations. Short wave treatment subsequent to abdominal operations sometimes is successful in effecting more rapid cicatrization of a fistula of the gallbladder.

In incipient claudicatio intermittens the author noticed a distinct improvement by short wave treatment. Cyanosis and cold of the affected extremities disappeared.

Localization of Pain Accompanying Faradic Excitation of Stomach and Duodenum in Healthy Individuals. Edward A. Boyden, and Leo G. Rigler.

J. Clin. Invest. **13**:833 (Nov.) 1934.

An experimental method has been devised whereby the gut may be stimulated, electrically, through the metal end of a stomach tube. As observed under the fluoroscope, excitation with a tetanizing current usually causes ring contraction of the stomach and duodenum.

Such spastic contraction is accompanied by sensations ranging from barely perceptible feelings of pressure to severe colicky pain. Such sensations are definitely localized under the upper quadrants of the abdomen — the subject pointing to the spot with his finger. As the electrode is drawn up through successive portions of the duodenum and stomach, the sites of pain progressively outline the position of these organs; but there is considerable aberrancy.

When the electrode is kept in one segment of the gut, but the body posture is changed, the site of pain usually shifts with it. Sometimes, however, the pain remains localized in one region after both the electrode and the body posture have been changed. This is interpreted as a temporary conditioning of the nervous pathways.

When an area of the skin to which the patient has pointed is anesthetized the pain migrates to a position outside the area, thus revealing that cutaneous nerves are involved in spastic contractions of the gut.

These experiments are interpreted to mean that localization of visceral pain arising from spastic contraction of the gut is a viscerocutaneous radiation due to splanchnic bombardment of somatic neurons.

At the same time that the pain migrates from an analgesic area it continues to be felt under that area. The similar persistence of visceral pain in animals after section of all thoracic nerves suggests that perhaps visceral pain is normally an integration of impulses from both splanchnic and cutaneous sources and explains why such pain tends to follow the course of the gut. Confirmation of this theory awaits experiments with patients in whom the thoracic nerves have been cut.

A Differentiation Between Photosensitized and Ultraviolet Effects on Frogs. H. F. Blum, and C. R. Spealman.

Am. J. Physiol. **109**:605 (Oct. 1) 1934.

Certain similarities may be pointed out between the effects of ultraviolet radiation on living systems and the effects produced in the same systems by visible light when a photosensitizer is present (photodynamic action). It has been frequently assumed that the two phenomena are similar or identical in nature, the photosensitizing dyes simply serving to extend the ultraviolet effects into the visible spectrum.

Photosensitized frogs irradiated with visible light exhibit similar reactions to those produced in non-sensitized frogs irradiated with ultraviolet light. The two effects may be differentiated, however, by the fact that ultraviolet effects occur in the presence or absence of O_2, but the photosensitized effects only in the presence of O_2. Thus the two processes must be considered as essentially different.

Ultra Short Wave Therapy in Internal Medicine. (Die Ultra-Kurzwellentherapie in der inneren Medizin.) Erwin Schliephake.

Ärztl. Praxis **1934**:249 (Oct.) 1934.

Short wave therapy aims at avoiding operations and curing diseases which hitherto were amenable to surgery only. The usual physical remedies worked indirectly from the surface of the body without penetration either as a reflex or by releasing efficacious elements out of the skin which by themselves stimulated defensive powers. Ultrashort waves affect directly the seat of disease in the depth of the body. Currents of low frequency (including diathermy currents) all of which are supplied to the body by contact, follow Ohm's law. They are running along the conducting paths of least resistance, mainly in the blood vessels shunning all organs that are enveloped by fat and fascia. The heat the currents provoke is most intense where they pass through tissues that offer highest resistance, especially the subcutaneous connective tissue. The electric field at a wavelength of less than 15 m. is bound to other rules; with correct adjustment of the electrodes — a relatively large space between them is obligatory — the field works upon and penetrates all layers of the body evenly, the intensity of effect upon the separate structural elements depending on certain constant values of material on the one hand, and on the wavelength on the other hand. In experiments on animals it was established (1) that by certain wavelengths elective injuries of certain cellular elements might be caused, (2) that the short wave field is being the more strictly localized the shorter the wavelength. All characteristics mentioned about short waves are of importance for therapeutic use, not only upon the seat of disease but also with regard to injuries to the surrounding tissue. The author points at the relation between the healing effect and possible injuries being just a very beneficial one with short wave therapy. The acceleration of circulation of blood in the sound tissue provides a continued outlet for the generated heat, reactive hyperemia augments this outlet. Abscesses, tubercles and many other foci of disease lack blood circulation entirely or partly, thus the heat within them increases it more intensely with a decided effect upon the atiologic factor.

In internal medicine the problem is the treatment of diseases spreading far into the depths of the body. The author treated all types of pulmonary abscesses and pleural empyema. No failure occurred in 10 cases of pulmonary abscesses. The healing process required 3-6 weeks, in one case only 17 days. Immediately after the first treatments the general condition improved and the temperature

abated. Later there was noticed a change in the expectoration from purulent to mucous consistence. X-ray pictures likewise display gradual improvement everywhere. In addition to abscesses, pleural empyema, interlobal empyema and chronic pneumonia were successfully treated.

Beneficial results were obtained with angiospastic processes, except when there were serious changes of the vessel walls as in a beginning arteriosclerotic gangrene and in angina pectoris. In migraine too frequently sudden improvement resulted. The author cautions that we should not consider short waves as a panacea.

Electrodes in Short Wave Therapy. (Zur Elektrodenfrage in der Kurzweilentherapie.) Telemann and Fritsch.

Med. Klinik. **31**:54 (Jan.) 1935.

Air-spaced electrodes according to Schliephake should be applied for maximal deep effect, especially in intensive irradiation of the thorax and of the abdomen. With large air intervals up to about 5 cm. best deep effects resulted, provided very short waves of great intensity with thermionic valve machines were employed. For spark gap machines air-spaced electrodes may be used under certain conditions only.

To obtain a deep effect the most adequate distance of the electrodes is an interval by which with maximal output of the machine a continuous, invariable (not gradually increasing), pleasant sensation of heat and good heating of the skin is produced.

Flexible condenser electrodes are well adaptable: (1) when it is not a question of maximal deep effect (any treatments practicable in the out-patient department of thinner parts of limbs may be counted among those); (2) when maximal heating is not generated below the electrodes (longitudinal treatment of limbs); (3) when surface effect only is intended (skin diseases).

Felt used for spacing flexible electrodes should be perforated like a sieve, in order to create similar conditions as with air-spaced electrodes. To avoid injurious heating they must be kept dry.

Generally the surface of electrodes should be larger than the seat of the disease.

Basedow's Disease and Its Treatment. (Der Basedowkropf und seine Behandlung.) Ernst Treibmann.

Münch. med. Wchschr. **82**:261 (Feb.) 1935.

The author had been struck for a long time by the influence of high frequency currents on endocrine glands. Patients of very advanced age who for reasons other than gland trouble were submitted to high frequency currents showed their favorable influence on the gonads. These observations doubtlessly indicate improvement of the functions of glands through high frequency currents. The same results occurred with Basedow's disease. Retrogression of nervous phenomena took place, at times it did so after the very first exposure. The patients calmed down, reported that they had slept well again and that distressing palpitations of the heart had ceased. At the same time objective retrogression of the goiter was noticed and in one case — distinct retrogression of a large exophthalmus. The patients put on weight, their general conditions improved. A multiple electrode was constructed for being buckled on. Purposely several glass electrodes were put together as it was obvious that a single electrode gets heated very fast while with three electrodes the divided current causes no heating worth mentioning. This multiple electrode was buckled loosely around the neck. The patient may be either lying on a couch or sitting. The cable of the multiple electrode was connected to the high frequency machine, half intensity was put in circuit for a half hour's to one hour's exposure. This is a very convenient and successful procedure which may be used repeatedly if relapse should occur.

The Partial Cauterization of Pleural Adhesions by Closed Intrapleural Pneumolysis. James Hedges Forsee.

Am. Rev. Tubercul. **30**:287 (Sept.) 1934.

Critical analysis of 7 cases of partial cauterization of pleural adhesions by closed intrapleural pneumolysis warrants the following conclusions: Incomplete cauterization is most suitable for large band — or diffuse fold-shaped adhesions situated laterally or apically. Thoracoscopy should be performed in all cases in which the above types of adhesions interfere with satisfactory pulmonary compression and further operative procedures determined by the thoracoscopic findings.

Satisfactory results were obtained in 71 per cent of the 7 cases treated by partial cauterization. The electrosurgical method is the one of choice in performing partial cauterization.

Factors Determining the Effect of Exercise on Blood Sugar in the Diabetic. Russell Richardson, and Alma L. Case.

J. Clin. Invest. **13**:949 (Nov.) 1934.

The work of Lawrence, and Hetzel, and Long and others has established certain facts regarding the effect of exercise on blood sugar in diabetic individuals. Sixty-one persons were examined by means of a standard form of exercise to determine whether diabetics differ in their response to exercise and whether the severity of the diabetes influences the response. It seems certain that carbohydrate exchange is accelerated during exercise. Such acceleration should accentuate deficiencies which might pass unnoticed during the resting state.

Electrocoagulation of Cervical Erosions and Endocervicitis in the Late Puerperium. A Study of Follow-up Results in a Series of Patients Delivered at the Woman's Hospital. Ralph L. Barrett.

J. A. M. A. **103**:1516 (Nov. 17) 1934.

A series of patients with damaged cervices during the late puerperium were treated. The method was electrocoagulation. By its use heat is generated

in the tissues, penetrating deeply enough to destroy the diseased tissue and to cause instantaneous thrombosis and so prevent hemorrhage. Electrocoagulation produces a complete cellular necrosis, is unaffected by the mucus of the cervical canal, and is not subject to the self-limiting action of charring and carbonization that occurs with the actual cautery.

The cervix of 120 patients was coagulated and kept under observation for three months after completion of the treatment. All the cervices were treated by a uniform technic. All treatments were carried out under local anesthesia of 2 per cent nupercaine applied topically on cotton pledgets. The coagulation is easily and quickly accomplished by a sweeping motion over the entire diseased area producing a white or grayish coagulum, carbonization indicated by excessive sparking, being avoided at all times. Experience has taught that the best results are obtained by light rather than heavy or deep coagulation, the penetration being, as a rule, from 2 to 5 mm.

The first seven to fourteen days following coagulation there is a free leukorrhea, often blood tinged. This persists until the coagulum has separated, after which there is rapid healing, usually complete in from four to six weeks. By the fifth or sixth week it has been found that the cervix has shrunk to normal dimensions, lacerations are healed and all eroded surfaces are completely epithelialized.

All patients in this series were carefully selected to exclude any pelvic inflammatory disease. It is perhaps due to this careful selection that there was no lighting up of pelvic inflammatory reaction following coagulation. In this group there are no unhealed cervices and no gross pathologic conditions evident. All patients in this series were treated in the office or outpatient department.

Tuberculosis of the Larynx. G. McD. Van Poole.

Arch. Otolaryng. 20:152 (Aug.) 1934.

The author's treatment makes use of vocal rest as a fundamental regimen for all the patients with laryngeal involvement. He is aware of the controversy regarding this measure, but asserts that such decreased activity as may be achieved must be of distinct value, and, indeed, is a clinical measuring rod.

Electrocautery is by far the most satisfactory treatment in the majority of cases. It owes its beneficial action to the fact that it produces vascularization of the lesion, thus increasing the resistance of the area to further spread of the infection and promoting fibroblastic replacement of the lesion. In the clinic the cautery is used directly through a Haslinger short one-sided laryngoscope, or indirectly, using a laryngeal mirror. The throat is sprayed with cocaine hydrochloride, and the larynx anesthetized, using a mixture of two parts of epinephrine and one of 20 per cent solution of cocaine hydrochloride, applied with a camel's hair brush. A sharp-pointed cautery is used, brought to red heat and inserted to a depth of 1 cm. into the tuberculous area. The cautery must be removed with the current on full. The cautery treatment is repeated not oftener than every two or three months.

There are certain definite contraindications to the use of electrocautery. These are: rapid progression of the pulmonary lesion, unusually high temperature or any other manifestation of extreme toxicity; lesions of the larynx of the tumor type in which the inflammatory reaction resulting from cautery may seriously impair breathing by blocking the airway; idiosyncrasy to cocaine hydrochloride in the form of unusually rapid pulse and symptoms of shock appearing after the preliminary spraying with the drug.

Development and Form of Short Wave Thermal Zones in an Agar Body. (Entwicklung und Gestalt von Kurzwellen-Wärmebändern in einem Agar-Modellkörper.) Wolfgang Albrecht.

Ztschr. f. ges. exp. Med. 93:816 (June) 1934.

On the surface of blocks of 4 per cent agar, Agi. Hg was spread as a thermoindicator; from a short wave condenser field of a wavelength of 3.96 m. thermal zones were generated — made visible at the turning of the thermoindicator. The turning point of the thermoindicator in preliminary trials was established at 37 degrees C. The round condenser plates — being insulated by glass hooks from the agar block — had a diameter of 2.5 up to 10 mm., the agar layer to be heated had a thickness of 10-50 mm. When plates of equal size were used at both sides, the heated zone was band shaped with parallel borders showing practically the same width as the plates. When a large and a small plate were placed opposite a thermal zone shaped like a truncated cone resulted; its borderline was almost in conformity with the exterior connecting line between the outside surfaces of the plates. Accordingly the form of the thermal field may be provided preliminarily by the adequate choice of condenser plates. Heating always starts near the condenser plates, spreading against the field center until both zones effect a junction, developing a fusion and definite form of the thermal zone. The first outbreak of heat near to the plates is due to the thickness of field, on account of its bulging in the center; it is likewise due to the form of field that in penetrating very thick layers the heat may be limited to the area adjacent to the plates, providing the object extended beyond both sides of the plate area. If the condenser plates are separated by a large distance, extension of the parts of the object beyond the plate area is of importance for the formation of the thermal zone.

The author hints at the fact of enhanced conductibility — due to heating — and engendering a decrease of heat in the object, in case the wavelength in use would be larger or of equal value for maximal heating. On the other hand an increase of heat will take place if the wavelength is inferior to the value of maximal heating. As the heating process starts near the plates it is proper to apply a greater wavelength in order to obtain a thermal zone, the development of heat decreasing in the marginal area in course of time; in the center of the object, however, the heat is still advancing normally, hence resulting in an even penetration within the area of the entire thermal zone.

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